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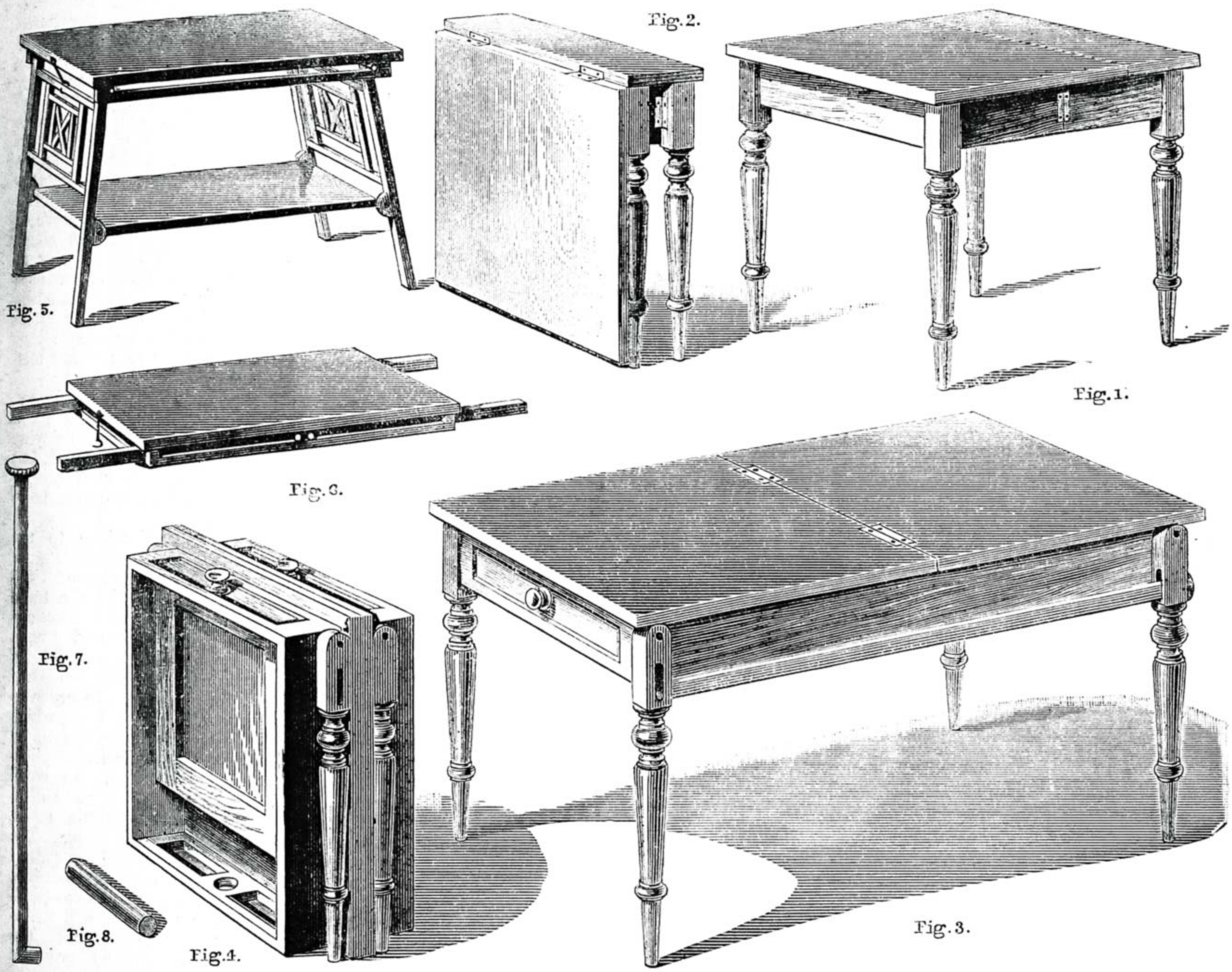

Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

Fig. 5.

Fig. 6.

Fig. 7.

Fig. 8.

Fig. 1.—Small Folding Table in ordinary Position. Fig. 2.—Ditto, folded. Fig. 3.—Larger Folding Table with Drawer in ordinary Position. Fig. 4.—Ditto, folded. Fig. 5.—Small Fancy Folding Table. Fig. 6.—Ditto, folded. Figs. 7, 8.—Strips of Wood to keep Table shown in Fig. 2 firm when extended.

A CHAPTER ON FOLDING TABLES.

BY JAMES SCOTT.

"NECESSITY is the mother of Invention;" but I have also heard it said that Invention is not the only child of Necessity, although I take it for granted that it is what may be termed the eldest child. Among the other children of Necessity are to be numbered Starvation and Robbery; but although she is the mother of these undesirable children, still there are other mothers who have children of the same names, and among them must be included Idleness.

But I must tackle my subject, instead of thus metaphorically speaking of a well-worn proverb. It greatly worries me when I visit any female relation on a Saturday to see the avoidable trouble to which she is put when house cleaning. First, she pushes tables, chairs, etc., to one-half of the room, and after sweeping and scrubbing, she transfers them to the other part of the room; and, finally, after having exhausted her patience, she places them in their original position. What a blessing if, for the time being, she could summon to her aid some fairy who would stow them away in his waistcoat pocket!

Necessity, then, to a certain extent is the cause of my designing the tables shown in the present article. It will generally be found that the folding tables already in the market are fancy articles for the drawing-room; or, if an extending table, the—sometimes—cumbersome screw dining-table. I have never seen such tables as I have shown to fold. Figs. 1 and 2 will be found the most useful.

I will do my best, then, to give the reader sufficient details to enable him to make any of these tables himself, if he feels so inclined.

Particulars as to wood, preparing, and finishing, are to be found in articles already published in WORK.

Fig. 1 is 29 in. high, from the bottom of

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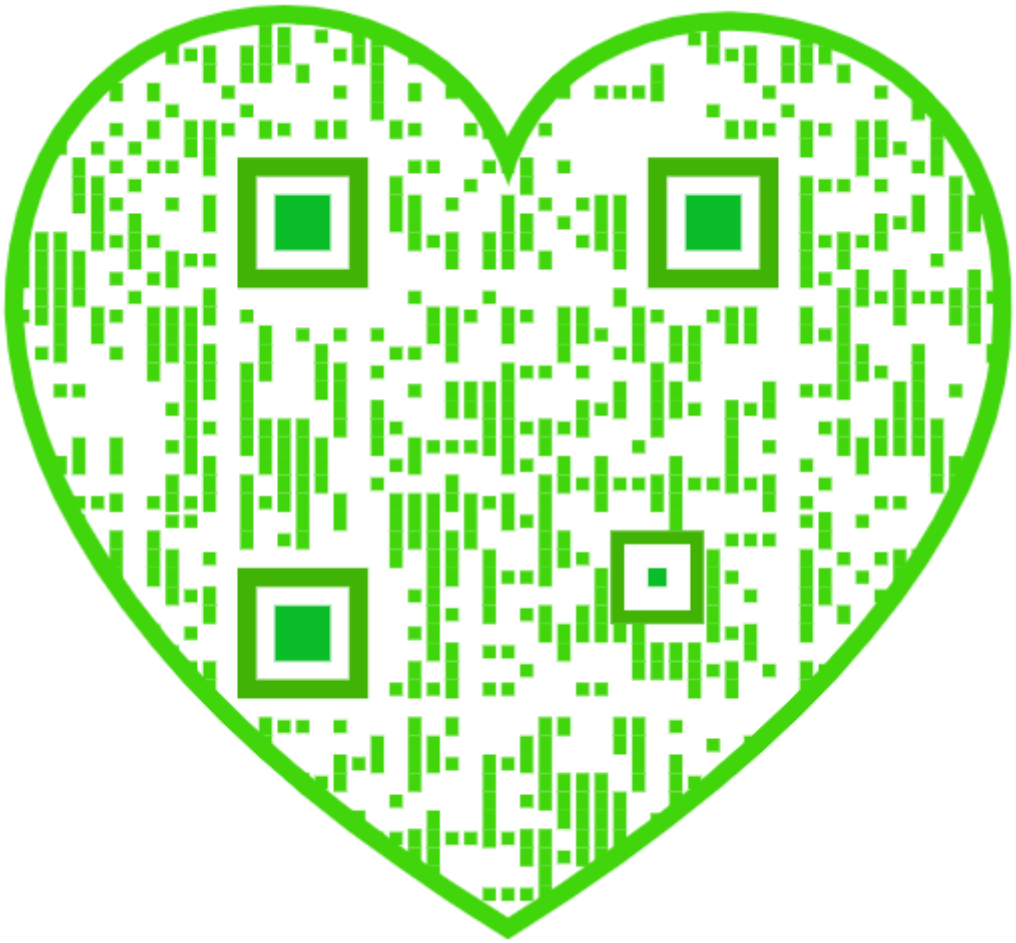

the leg to the top of the table. The top is 36 in. square, and is divided into two parts: one 29 in. by 36 in., the other 7 in. by 36 in. The large flap falls downward, and needs to be very strongly hinged to the smaller one.

The legs are turned from 2½-in. stuff, the blocks of which should be 7 in. long. Those attached to the smaller top piece should be very firmly joined. Those on the opposite side must not be fixed at all to the top.

The two end pieces which form the two immovable sides should be ½ in. thick, 5 in. deep, and 31 in. long. This length allows for joining it into the leg block. For the two movable—that is, folding—sides we require four pieces of the same depth and thickness, and each 15 in. long. Two of these form a side, and care must be taken to firmly screw the hinges on. I have shown some of the hinges on the surface of the wood, but they may be so fitted as not to be seen, as my reason for thus showing them is merely to indicate their position.

The top should be ¾ in. thick, and should overlap the outside of the leg blocks by ½ in. The framing, according to the requirements, should be hinged and joined to the *middle* of each block.

To keep the table in its expanded position a strip of wood 1 in. thick needs to be fastened on the large flap, underneath, and 1¾ in. from its outside edge.

Of course, it is impossible to provide this table with drawers; hence my reason for giving Fig. 2.

This represents a table 4 ft. 8 in. long, by 3 ft. wide, and 29 in. high. The top is divided and firmly hinged in the middle. The framing, etc., of each half is precisely the same, so that it is only necessary to describe one half. I have intended it to have two drawers.

The framing at each side should be 2 ft. 3 in. long, by 6½ in. deep and ¾ in. thick (see Fig. 3). The framing on the end should be 6½ in. deep and 31 in. long. This end piece should be so made as to leave a space for the drawer 5 in. deep and 28 in. wide.

Now we require something to keep our table from collapsing when it is extended. First, we must deal with the two backs which come together in the middle of the table, and which can be seen in Fig. 4. It can be a solid piece or cut out as I have shown, but it must have a hole cut through the centre. Fig. 8 shows a thick piece of rounded wood, which, when put through the two holes, will be sufficient to keep the table firm, if it is made the same thickness as the diameter of the holes.

Next, we must give attention to the legs. Each pair of blocks will have to be cut so as to receive the rod (Fig. 7) which passes through the first block and into the second, where it turns in the same manner as a key does in a lock, and will be a firm support for the legs. The blocks should be rounded off on their tops, and connected with the framing by an iron or wooden peg, upon which they work as a pivot. It must be remembered that the deeper the rods are fitted in the blocks, the more solid support they will afford; and if it is not considered too much trouble I should advise the maker to have legs with a block a good distance down, and have another pair of rods to fit into these.

As this table will occupy nearly 5 ft. space when extended, its folding will be a great advantage, as the space it will then take up will only be about 15 in.; so that, perhaps, it will be worth while to spend a good amount of labour on it.

The fancy table represented in Fig. 5 differs somewhat from the usual run of folding articles. In things of such a character, the aim in the design is to supply a table that will fold flat together, without one of its parts necessarily being disconnected from its fellow pieces. Another advantage to be gained by the use of table, Fig. 5, is that it will bear almost any amount of weight upon it when closed.

The top and the bottom board should each be ¾ in. thick, the former being 36 in. long by 18 in. wide, and the latter 36 in. long by 13½ in. wide. The four legs should each be 27 in. long, 1 in. wide, and ¾ in. thick. The fretwork should be firmly joined between each pair of legs, thus fastening them together. A hole should be bored through the top of each, to admit a rod in each pair 16 in. long. These rods should be fitted in after all the other part is put together.

The framing should be ½ in. thick, 1¼ in. deep, and 34 in. long, on each side of the table top, underneath; but no framing must be fastened on the ends. Each side piece should be cut through to allow of the free movement of the rods above mentioned. At 10 in. from the bottom of each leg should be a projecting piece of wood, through which a hole is bored, corresponding with a hole in the thickness of the bottom board, and through which a wooden or iron peg is driven to act as a pivot.

There are numerous methods to enable the table to be kept firm when being used. That which I have shown is as simple as needs be: it is merely a hook, the upper part of which moves in a kind of staple, and secures the legs from falling together.

This table will look well painted in either light or dark enamel. The two larger ones should be made of deal, with mahogany or oak stained or solid legs.

THE REGISTRATION OF DESIGNS AND TRADE MARKS.

BY C. C. C.

PROTECTION OF DESIGNS—DRAWINGS REQUIRED—FORM OF APPLICATION AND ITS COST—CLASSIFICATION OF DESIGNS—TRADE MARKS—DIFFICULTY IN FINDING NOVEL ONES—DRAWING REQUIRED—RULES AND INFORMATION.

THE registration of a design is a much more simple thing than taking out a patent. What we have to do in the first place is to provide three pieces of drawing paper, each measuring 13 in. by 8 in., and to make on each a drawing—the drawings being facsimiles of each other—in Indian ink, of the article or pattern which we desire to have protected. On applying for patents duplicates have to be sent in, but in this case *triplicates*.

Should the design be fairly simple in outline or pattern, we cannot do better than make the Indian ink drawings; but should the reverse be the case, and especially if our design will have to be printed for other purposes, time and labour will be saved by having it engraved or lithographed, and having three copies struck off, *without wording or trade mark*. These we may paste upon our sheets of drawing paper instead of making drawings.

We have now to apply at the Post Office for Form E (Patents, Designs, and Trade Marks Act, 1883 and 1885). It will be stamped with a red stamp, across which the word "Design" will be printed in black; for this we shall be charged 10s. In its margin we shall find directions for filling in the blank spaces between the printed matter. These forms are kept in stock at the more important post-offices, but may be obtained through any money-order office on prepayment of the value of the stamp.

In filling up this form, the one point which will specially require attention will be to determine the class to which the design will properly belong. Designs which have to be carried out in different substances, or which are to be applied to different kinds of articles in the same substance, have to be placed under different classes. Thus designs in or on paper generally come under class 5; but paperhangings are an exception. There is a class for bone and ivory, a class for jewellery, another for metal goods not included under jewellery, and so on. For full information upon this subject it will be well that every person intending to register a design should obtain a little pamphlet of instructions, issued by, and procurable from, the Designs Branch of the Patent Office, at the end of which he will find a table of the different classes and the subjects contained in them. It should be observed that the applicant will have to state whether his design applies to shape or pattern. This is not always easy to decide. The writer has more than once been obliged to claim *both*, and his claim has been allowed. The remaining matters in the printed Form E are so simple that no one can be in danger of making mistakes in filling up the blanks.

As regards the drawings, the stringent regulations laid upon the applicant for a patent are not insisted upon. The drawing or print must be in a permanent ink, but it is allowable to shade it with washes, if these will serve to render the design more distinct and definite.

In addressing communications to the comptroller upon designs, the words "Patent Office Designs Branch" should be used.

Any person seeking to register a trade mark is advised in the official instructions not to go to any expense in engraving until he has ascertained whether the design for that purpose which he proposes to submit will or will not be accepted. In order to learn this he has to procure a form, which he will obtain from the post-office as in the previous cases, make his formal application, and submit his design. In some classes of goods few things are more difficult than to secure a new trade mark, simple as the matter may seem. The writer's experience has chiefly been gained in connection with trade marks for needles. These come under the same class as Sheffield goods (cutlery); no mark will therefore be accepted by the comptroller, the appearance of which in any way approaches a mark already secured by any maker of saws, files, or such-like matters, and though the goods of the needle manufacturer can in no way be mistaken for or clash with those just mentioned, we have known drawing after drawing rejected by the comptroller, because it trespassed in appearance upon some mark used by a member of the Cutlers' Company or other metal worker. To secure a trade mark may therefore be a tedious and expensive affair. We could instance one manufacturer of high reputation in the needle trade who, after compassing heaven and earth to find a new and appropriate trade mark, was obliged at last to content himself with a dragon fly!

The form which the applicant will procure will be that marked F. It will have

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"Trade Mark" printed across the stamp, and the charge for it will be 5s. It will have blanks in the printed matter to be filled in according to the directions given, and in the middle will be a blank square. With this two other forms (duplicates) will be given to the applicant, each with a blank square in its centre, and in the blank squares of all three papers, drawings of the proposed trade mark must be affixed.

On the stamped form will have to be stated the class of goods for which the trade mark is wanted (for instance, if for needles it would be class 13), date and signature attached, and all three forwarded to the Comptroller of Patents Trade Marks Branch.

When about to register a trade mark, the applicant will do well to procure the small book of rules issued for his guidance, price 1s. It is sold by ten London houses, of which that of Messrs Waterlow and Sons, Parliament Street, is one; in Manchester by Messrs. Palmer and Howe, Bond Street; in Edinburgh by Messrs. A. and C. Black; and in Dublin by Mr. Alex. Thom, Abbey Street.

HOME-MADE TOOLS.

BY J. H.

Joint Boards and Surface Plates.

Joint boards or surface boards are used by engineers' pattern-makers, for the building up of work which is jointed or parted into two or more portions for convenience of moulding. Thus, in making an engine cylinder by the method of lagging, the first half pattern is built up with its joint face upon the board, and afterwards the second half is built upon the first. The reason why a board is used is twofold. First it is usually truer than the bench; which, although true in the sense of being free from winding, is not usually free from local inequalities and roughnesses; and second, the building up of work often necessitates the use of screws, staples, or other temporary attachments which it is not desirable to insert in the bench; and also glue from the glued joints drops down from the work, and would make the bench in a mess. But the joint boards being true can be kept so by occasional shooting, and any disfigurement due to nails or dogs is of little or no consequence.

These joint boards are used for a variety of other operations by wood workers. They not only afford a true basis for building up work, but also for taking vertical dimensions by means of rule and scribing block, checking or adjusting faces with set square or bevel, for lining off centres and dimensions, and sometimes for drawing out work upon. They are to the pattern-maker what the marking-off table is to the fitter.

A joint board (Fig. 1) is necessarily made of several strips of stuff. A piece of board in one width only would shrink and curve out of truth to some extent, in spite of the coercion of stout battens. Making the board in narrow strips, and uniting these with battens and open joints, shrinkage or swelling due to atmospheric influences is so very much localised that the general level remains true for an indefinite period.

A joint board may be made to almost any dimensions according to requirements. It will generally be more convenient to have it oblong. Perhaps the most generally useful dimension would be from 4 to 5 ft. long, by about 2 ft. wide. Supposing it is 2 ft. wide, make it in four strips of 6 in. wide each, or in three of 8 in. wide. It is not necessary to plane to thickness and width, but it is a neater method. At least, the strips should be planed to a parallel width to make the slightly open joints, say $\frac{1}{32}$ in. open, of about equal width throughout. If they are not planed to thickness, then the best plan is to make one face true and gauge and rebate narrow faces on the opposite side to take the battens.

The battens should be stiff. They may measure from 3 to 4 in. in width by $1\frac{1}{4}$ in. or $1\frac{1}{2}$ in. in thickness. They will be screwed to the strips in such a way that a slight amount of expansion and contraction will be allowed to the stuff. To do this, make the screws a slack fit in their holes in the battens. Put two screws from each batten into each strip, arranging them diagonally, and about in the position shown in Fig. 1.

It would be as well to let the board remain at this stage for a few days before planing it over, in order to allow any twist due to the exposure of the new surfaces, and the tension caused by screwing the parts together, to develop itself.

To plane it over true, we require the assistance of a straightedge rather longer than the board, and of a pair of winding strips. In a board of this length there will, unless the stuff is very thick, be an amount of elasticity which will permit it to accommodate itself to some extent to the bench, or trestles, on which it is laid. For this reason the stuff should be thick, not less than $1\frac{1}{2}$ in. in a board of the length we suppose we are making. And always before building up anything upon the board, it should be levelled on the bench or trestles with wedges or blocking pieces, using winding strips and straightedge for the purpose of testing. To plane the board over, in the first place the bench should be true, so that the board may be laid upon it in the most favourable condition. Its surface is then tried with winding strips, the strips being placed transversely near the ends. The straightedge is then tried lengthwise to check condition of surface which lies between the extreme ends just tried with the strips.

The surface may be free from twist as tested with the strips near the ends, but the intermediate portion tested lengthwise may be curved more or less, being either convex or concave. Or the surface longitudinally may be straight, but the ends winding in relation to one another. If the surface is true, not only longitudinally, but also diagonally, when tested over cross corners with the straightedge, then there is no winding. To face the board true, the trying plane must be sharp, and its iron adjusted as straight across as it is possible to work with, and set fine. A board made of well-seasoned stuff, put together in the way described and shot true, should last good in constant use for from six to twelve months without requiring to be reshot.

In making these boards there is no attempt to check one with another as in the straightedges and surface plates, the direct tests of straightedges and winding strips being sufficient for the purposes for which they are required. It is essential, of course, that the winding strips, etc., used in testing be themselves as true as possible.

Surface plates and lining-off tables are made in various forms and sizes. The lining-off table is used by the metal worker for the same general purposes as the joint board of the wood worker. The proper function of the surface plate is of a somewhat different character. Work is marked out on the lining-off table, and small work is built up thereon, or is taken thither for checking the accuracy or otherwise of lines and centres. The true and only legitimate function of the surface plate is the testing of faces and edges to which it is desired to impart the highest possible degree of accuracy. The functions of the two being distinct from one another, they are prepared by different methods. In their general form they are similar, consisting in each instance of a broad plated surface, well stiffened with vertical ribs underneath. But while the lining-off table is simply planed over, and so left, the surface plate is planed, filed, and scraped. The former is approximately true only, the latter absolutely so. The general truth of the broad area alone of the former is of importance; in the latter every minute localised section of area is in the same absolute plane with the rest. The former is easily and quickly prepared, the latter involves the labour of many days, perhaps of weeks.

Unless the aid of a true surface plate already in existence is available, it is absolutely essential to perfect accuracy that three surface plates be made. This, however, is a task in which three skilful amateur metal workers might well engage and take equal shares in the expense and labour.

For all work of large and moderate size, surface plates are made of rectangular and oblong forms; for very small work they are often circular (Fig. 4). In each case patterns are required, and they are to be constructed so that the face shall be cast downwards. It is best for this purpose that the stiffening ribs be only dowelled upon the plate, and they will be thinner upon the top edge than at the bottom. If the plate is large, diagonal stiffening ribs (Fig. 3) will be required in addition to those which run round the edges. If the plate is small, say 15 in. or 18 in. long, hand-holes should be cast in the two end ribs to lift the table by. If large, say two feet or over in length, handles of wrought iron are screwed in (Fig. 2, B). But such tables are only used in large workshops. The design shown in Fig. 3 will answer very well for tables up to about 24 in. long. The drawing is proportional for any dimensions below 24, so that a table of any length, from say about 8 in. × 6 in., which is about the smallest that is worth one's while to make, upwards to 2 feet, can be scaled from the drawing.

The oblong tables are the most useful. The rectangular surface is handier than the circular, and the edges afford a convenient base for the trying of the square across. But many small circular plates are made (Fig. 4). They are then commonly of the form in Fig. 4, the three legs enabling them to stand steadily on an uneven bench.

The making of surface plates is not an essentially different operation from that of straightedges and winding strips.

Having received the castings, grind over the surface and edges to see if they are sound before spending any other labour upon them. Then if they can be planed over in a planer or shaper, so much the better. If not, go to work with coarse file and straightedge until the surface of each is reduced to a fairly level condition.

If the surface plate is of small size, the file may follow immediately after grinding. If it is of moderate or large size, and in any case if its surface is uneven and rough, it must be chipped before the file is employed. The chipping should be commenced with a narrow cross-cut of about $\frac{1}{4}$ in.

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in width, cross-hatching the surface with a series of shallow grooves. The truth of the grooves from edge to edge will be tested with a straightedge. Afterwards, the metal between the grooves will be removed with an ordinary broad-faced chipping chisel. When chipping near the edges, do not cut outwards towards the edges lest they become broken out, but strike inwards. Test the general level from time to time with a straightedge, and get it as accurate as possible with the chisel, because it is quicker and easier to chip than to file. It will also be found that by cross-hatching, it is much easier to get below the hard skin, and a truer surface can be obtained in less time than by using the broad chisel in the first place.

In the first rough stage of filing, when the chisel marks are being obliterated and the surface brought to a general level free from winding and curvature, no special precautions are necessary except the testing with straightedges. When the finer files are brought into requisition, their efforts will have to be more precisely localised, and red lead paste will be smeared over the straightedges, and transferred thence to the surface of the plate.

Not until we have done all that can be done in this manner is there any advantage in testing the plates by mutual contact. This will be done when we are using the superfine file and the scrape.

At these stages we shall get each plate first as true as possible, quite independently of the other, and then test each by the others.

It will be rather surprising when these plates, to all appearance true when tested singly by straightedge, are brought together in succession with red lead on their faces, to note how small a portion of the colour will be transferred from one to the other. Such being the case, we shall have no difficulty whatever in selecting the higher-coloured portions, and removing material with the point of the fine-cut file, and this alone will occupy us some considerable time. By-and-by, when the colour becomes more equally distributed, it will not be easy to localise the action of the file, and it is at this crucial stage, therefore, that the scrape has to be brought into service. By means of this tool the most minute localisation of action is possible, and the only limit to its use is the patience of the operator, as under the action of the scrape the number of minute points of contact made between the several plates increases, the action of the scrape is more and more localised, and the red lead mixture is made thinner and thinner until it is a mere film of coloured oil, and presently even this will be superfluous. It is better in the latest stages to trust simply to the contact of surfaces, the polish produced by the rubbing of the metallic surfaces upon one another being sufficient to indicate the higher points. At the last stage the surface of the plates will be covered with these points, imparting that lustrous appearance common to all scraped work.

So intimate is the contact of surfaces in plates which have been prepared with the utmost perfection, that the upper one is capable of lifting the lower. Professor Tyndall attributes this to molecular attraction rather than to atmospheric pressure, because the same effect follows in vacuo as in air. In surface plates not prepared with this high degree of accuracy, there is nevertheless a very sensible force required to pull them asunder. When the plates are put together, the upper one floats for a while on an interposed film of air, and when this is squeezed out, it requires a good pull to separate the plates, unless the top one is slid sideways off the lower one.

After taking so much pains to produce true plates, we cannot do otherwise than treat them with consideration. Work should not be tumbled about or hammered upon their surfaces. If lining out is done for the sake of convenience upon them, care should be taken not to scratch or otherwise impair their smoothness. They should be wiped clean with waste or with a wiper after use, and when not in use should be covered with a wooden cover as shown at A in Fig. 2, in position on the surface plate. The cover consists of a board carefully jointed if necessary, on account of size, with a ledge screwed on round the edge.

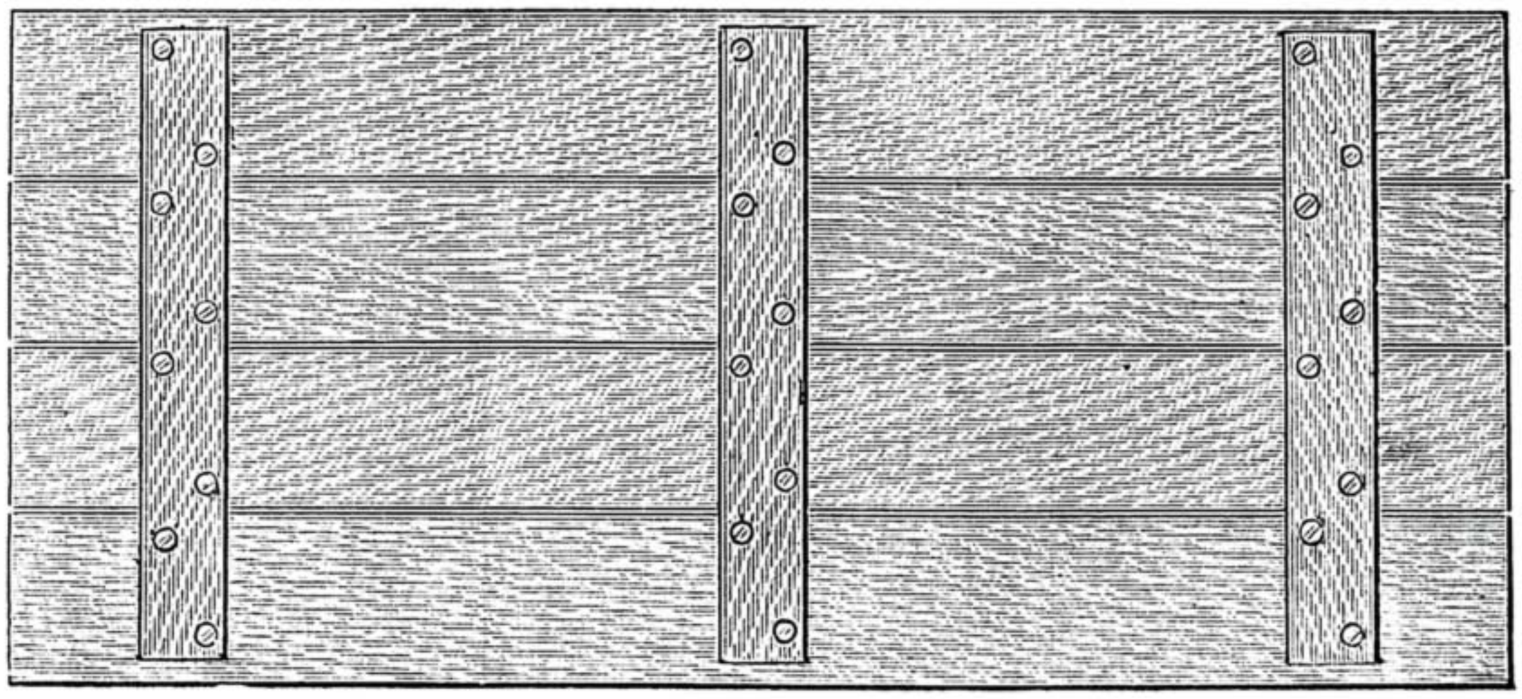


Fig. 1.—Joint Board in Plan seen from the Back—A, End View.

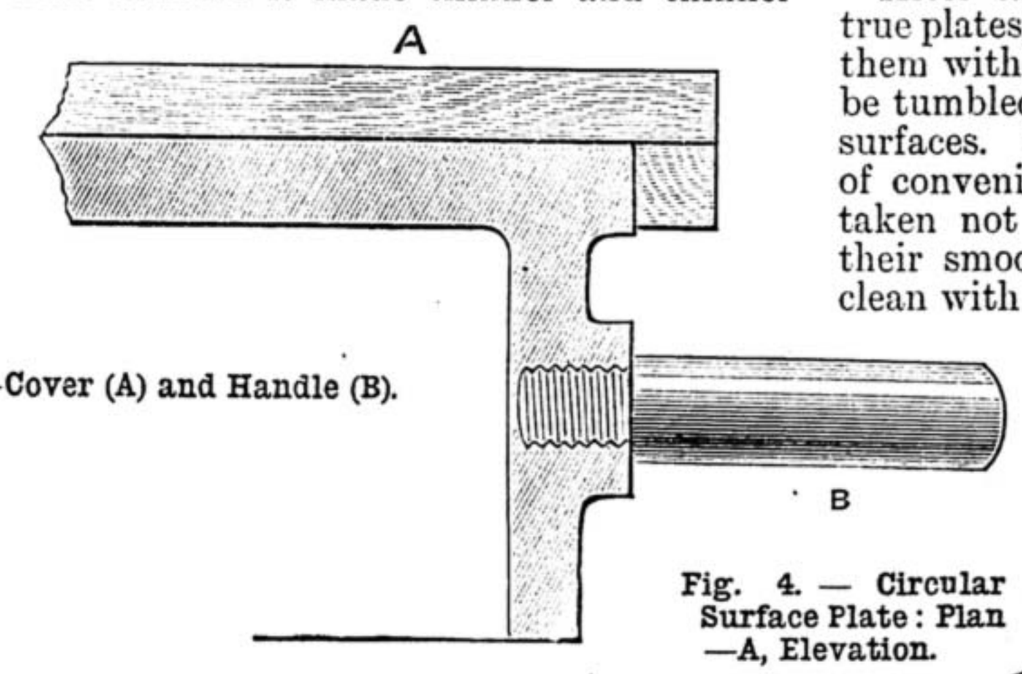


Fig. 2.—Cover (A) and Handle (B).

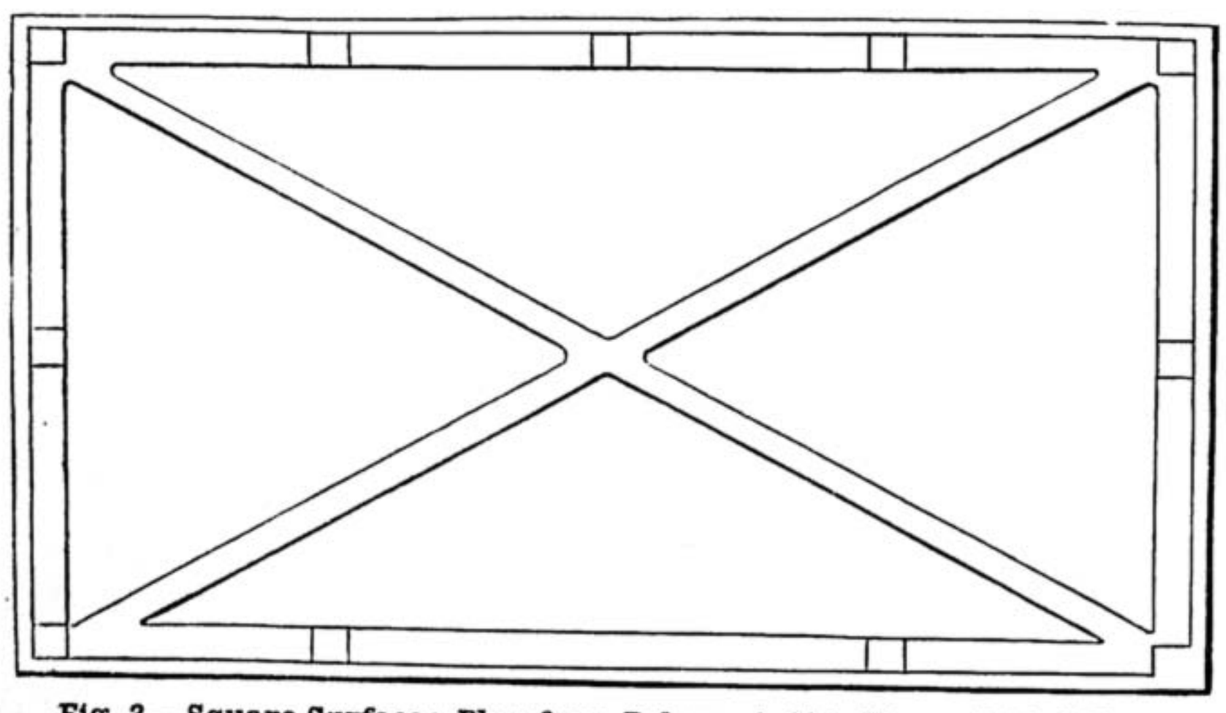
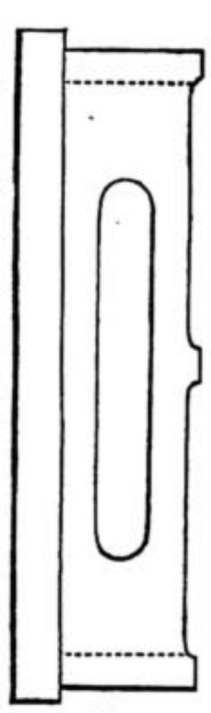


Fig. 3.—Square Surface: Plan from Below—A, Side View; B, End View.



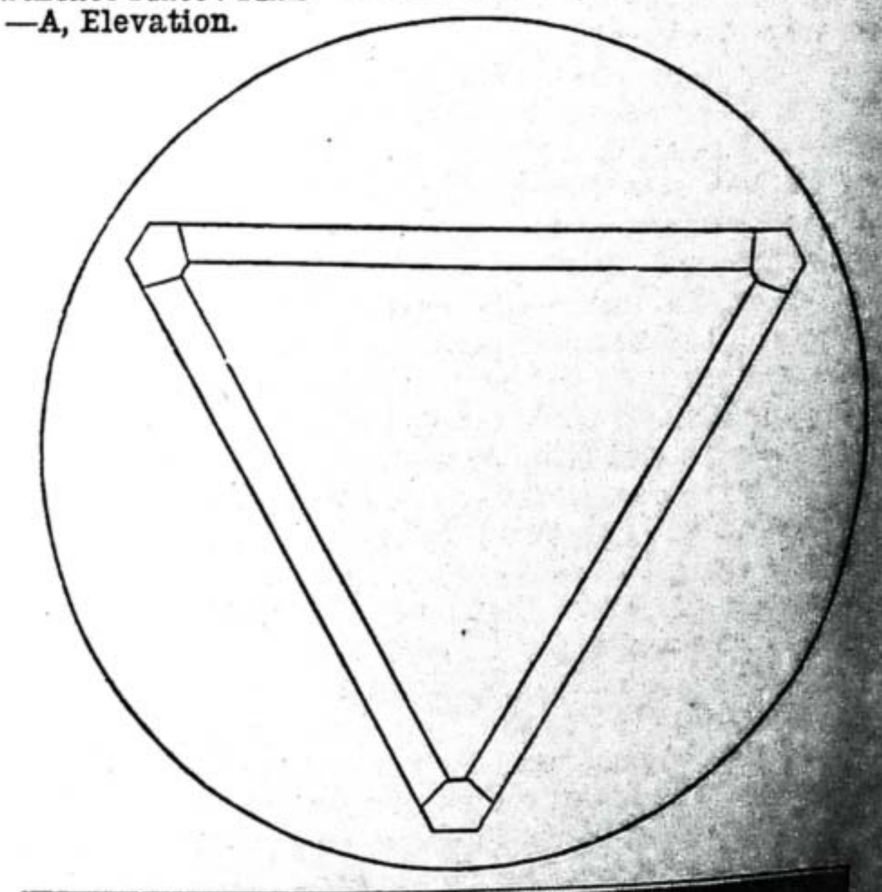
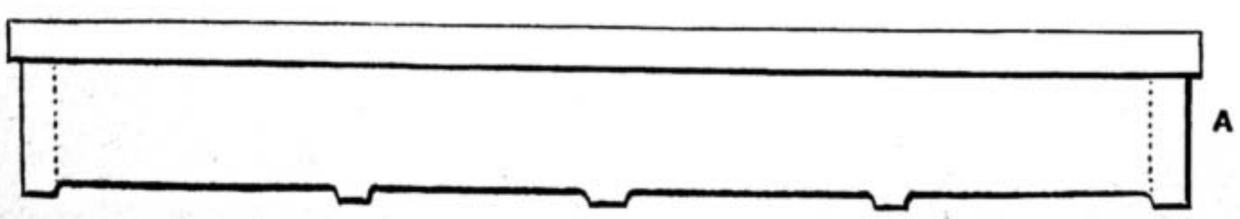


Fig. 4. — Circular Surface Plate: Plan —A, Elevation.



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TOOTHED GEARING.

BY FRANCIS CAMPIN, C.E.

WHEN one shaft is required to be driven from another, and the relative velocities of the two rigidly maintained, frictional contact is not to be relied upon, and, whether for light or heavy machinery, toothed or spur wheels must be used, and these so constructed that they move together in exactly the same way as they would were the motion communicated by the mutual contact of their circumferences. To determine the form of tooth by which the required motion can be transmitted is the question now before us. In Fig. 1 let E and F represent two circular discs of which the centres are at A and B, and let them be in contact at the point C; then, assuming that there is no particular resistance, if one disc be turned, the other will revolve with it by reason of the friction at C. Upon the disc E let there be a tooth, the face of which is shown by the curve *dd'*, which cuts the circle E in the point 4. Divide the arc C4 into any number—in this case four are taken—of equal parts, and mark off the same number of equal parts on the circle F from C, making the arc C8 equal to the arc C4. Now if the disc E be turned in the direction of the arrow *h*, the disc F will revolve in the direction of the arrow *i*, and the points 2 and 6, 3 and 7, and 4 and 8, will successively come together at the point C. Now it is required to make a tooth which, fixed on the disc F, shall, during this movement, remain in contact with the curve *dd'*. It is evident that, at each successive position, the distance from the point of contact, C, to the point of contact of the teeth, will be equal to the corresponding least distance from the points 1, 2, 3, etc. Therefore, to find points in the side of the tooth on F, so that it shall work properly with *dd'*, and remain always *in contact* with it, proceed thus:—Placing the compass-point at C as a centre, open the compasses till the pencil touches the nearest point of the curve *dd'*, and draw the arc *e*9; then take in the compasses the shortest distance from point 1 in circle E to *dd'*, and using point 5 in circle F as a centre, draw the arc 9, 10, meeting *e*9 at 9; in like manner take the shortest distance from 2 to *dd'*, and from the centre 6 draw the arc 10, 11, meeting the arc 9, 10, at 10; then from 3 take the shortest distance to *dd'*, and from 7 as a centre, with it as radius draw the arc 11, 8, meeting 10, 11, at 11; and then the points *e*, 9, 10, 11, 8, will be points in the side of a tooth that will remain in contact with the curve *dd'* during the revolution of the discs through the arc C4. The more of these points that are taken, let me say, the more correctly will the form of tooth be given.

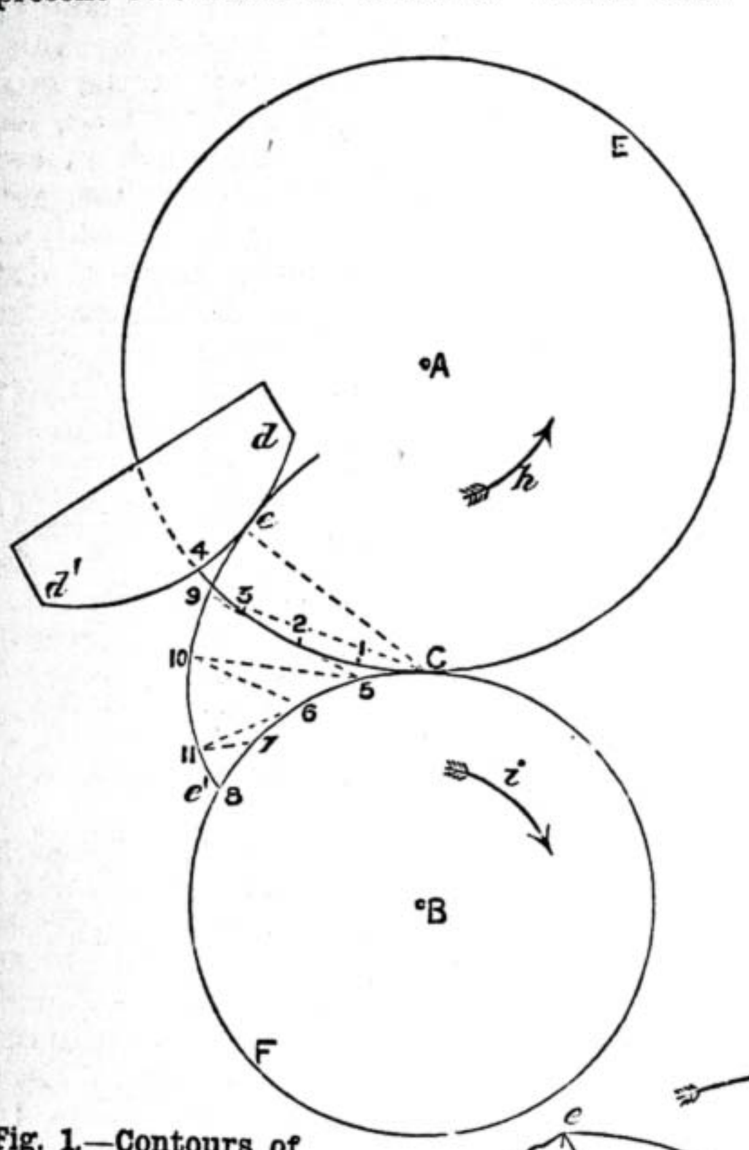

Fig. 1.—Contours of Teeth.

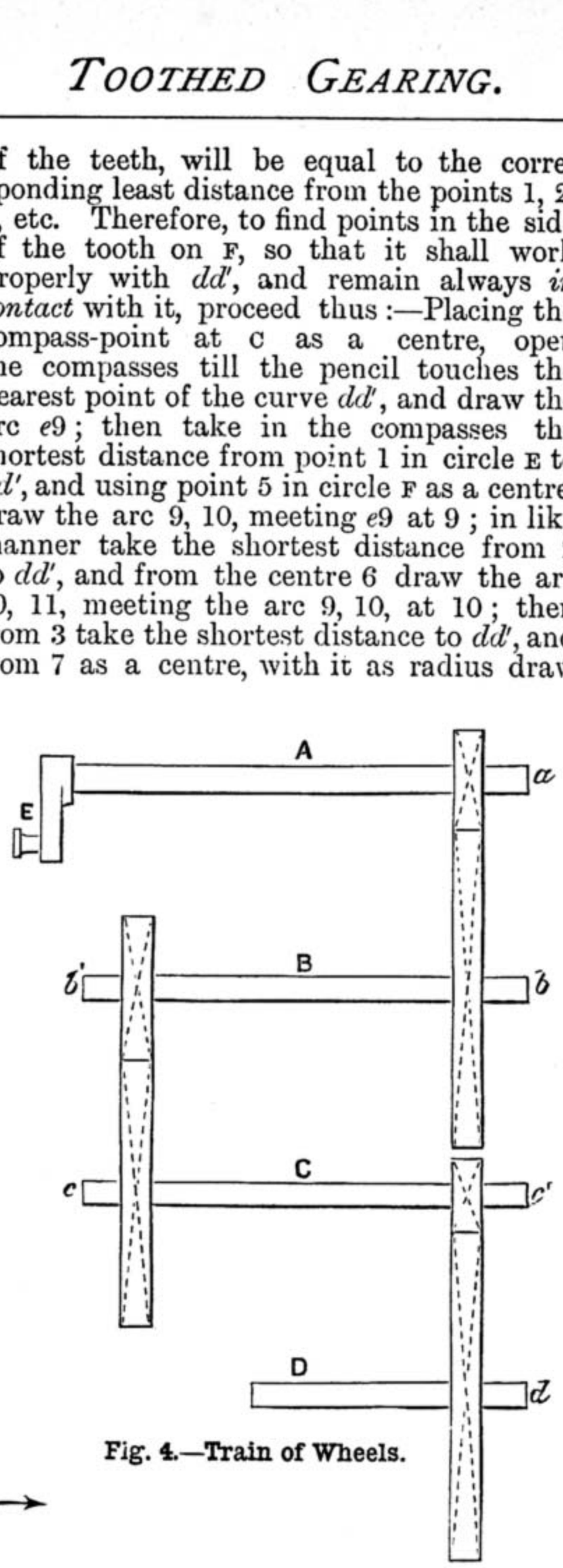

Fig. 4.—Train of Wheels.

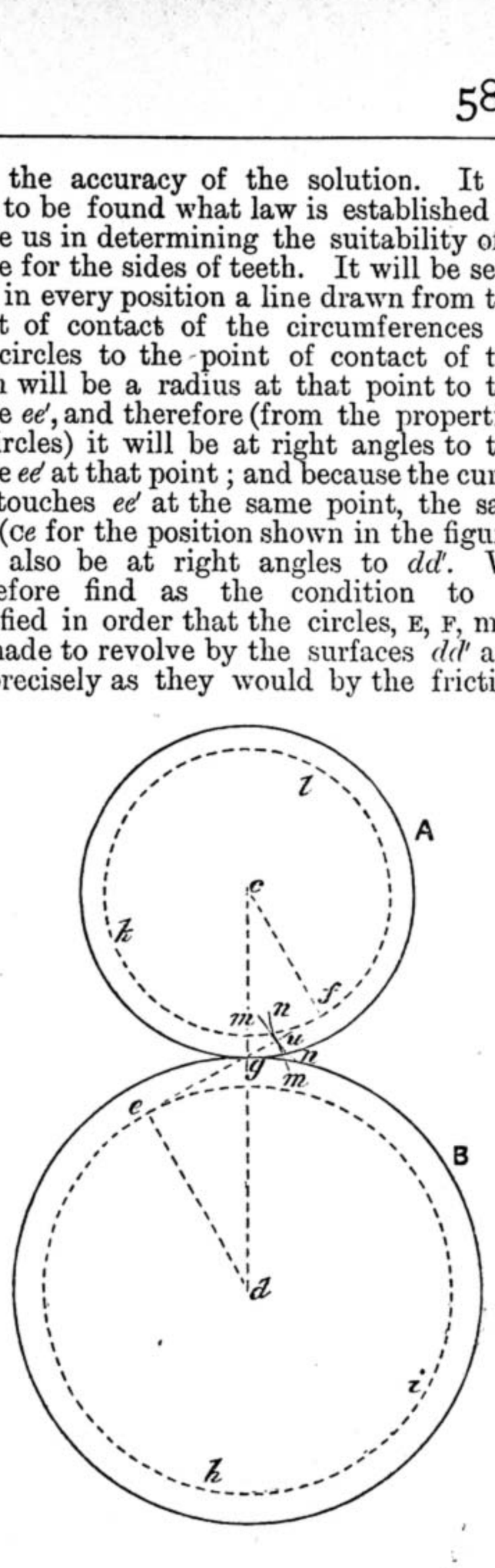

Fig. 3.—Involute Teeth.

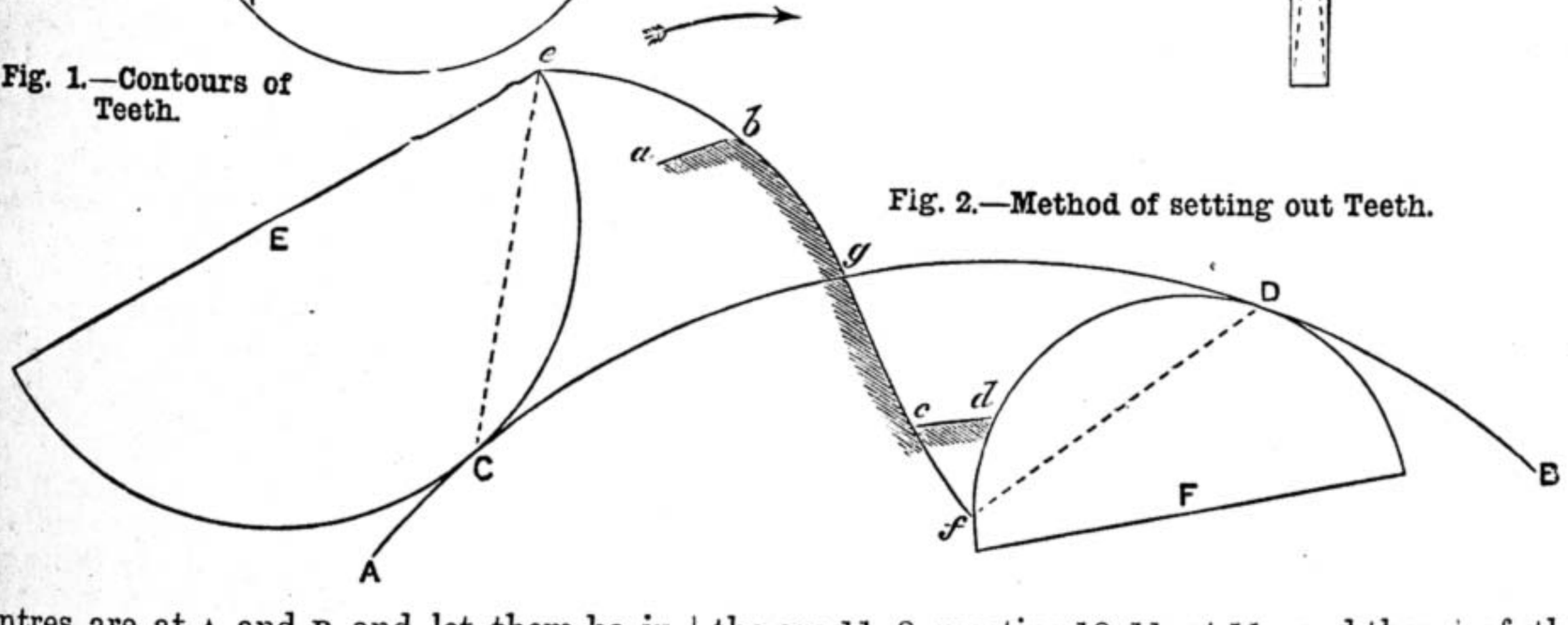

Fig. 2.—Method of setting out Teeth.

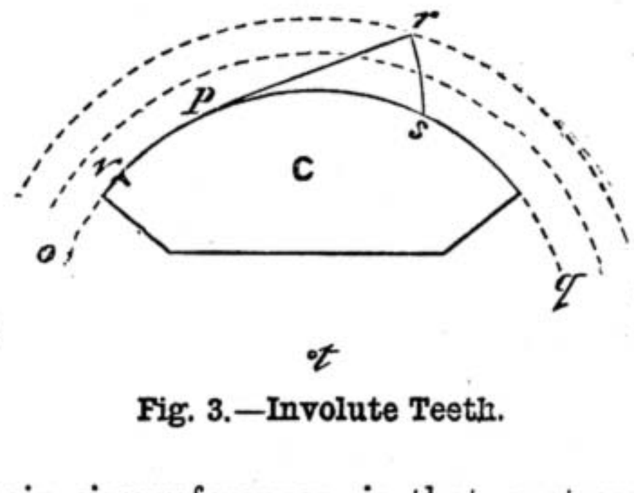

Fig. 3.—Involute Teeth.

And let there be a second tooth, the face of which is shown by the curve *ee'*, which cuts the circle E in the point 9. Divide the arc C9 into the same number of equal parts as the arc C4 was divided into, and mark off the same number of equal parts on the circle F from C, making the arc C11 equal to the arc C9. Now if the disc E be turned in the direction of the arrow *h*, the disc F will revolve in the direction of the arrow *i*, and the points 2 and 6, 3 and 7, and 4 and 8, will successively come together at the point C. Now it is required to make a tooth which, fixed on the disc F, shall, during this movement, remain in contact with the curve *ee'*. It is evident that, at each successive position, the distance from the point of contact, C, to the point of contact of the teeth, will be equal to the corresponding least distance from the points 1, 2, 3, etc. Therefore, to find points in the side of the tooth on F, so that it shall work properly with *ee'*, and remain always *in contact* with it, proceed thus:—Placing the compass-point at C as a centre, open the compasses till the pencil touches the nearest point of the curve *ee'*, and draw the arc *e*10; then take in the compasses the shortest distance from point 1 in circle E to *ee'*, and using point 5 in circle F as a centre, draw the arc 10, 11, meeting *e*10 at 10; in like manner take the shortest distance from 2 to *ee'*, and from the centre 6 draw the arc 11, 12, meeting the arc 10, 11, at 11; then from 3 take the shortest distance to *ee'*, and from 7 as a centre, with it as radius draw the arc 12, 8, meeting 11, 12, at 12; and then the points *e*, 10, 11, 12, 8, will be points in the side of a tooth that will remain in contact with the curve *ee'* during the revolution of the discs through the arc C4. The more of these points that are taken, let me say, the more correctly will the form of tooth be given.

As in this lies the proof that the teeth can be made to work together concurrently with the natural motion due to mutual contact of the circumferences, and therefore can be used to make one disc drive the other in the same manner as, but without, the contact of the circumferences, I strongly advise the student to set this problem out on strong Bristol drawing board, so that it may be made into a working model, this method of investigating such matters impressing their results firmly on the memory, besides convincing the inquirer by the most satisfactory of all proofs—ocular demonstration—of the accuracy of the solution. It is now to be found what law is established to guide us in determining the suitability of a curve for the sides of teeth. It will be seen that in every position a line drawn from the point of contact of the circumferences of the circles to the point of contact of the teeth will be a radius at that point to the curve *ee'*, and therefore (from the properties of circles) it will be at right angles to the curve *ee'* at that point; and because the curve *dd'* touches *ee'* at the same point, the said line (C*e* for the position shown in the figure) will also be at right angles to *dd'*. We therefore find as the condition to be satisfied in order that the circles, E, F, may be made to revolve by the surfaces *dd'* and *ee'* precisely as they would by the friction of their circumferences, is that a straight line drawn from the point of contact *e* of the teeth to the point of contact C of the circles must in every position of the point *e* be at right angles to the surfaces in contact there.

As we may take an infinite number of points between C and 4, it is evident that the radius is continually changing for the side of the tooth, and therefore a curve made up of circular arcs will only approximate to the strictly correct form. There are, however, some curves which may be easily set out which answer exactly to the conditions required, and these, and the methods of applying them, I will now describe, premising, however, that the circles E and F, which would be in contact if there were no teeth, are called the *pitch-circles*, and that the part of the edge of a tooth *outside* the pitch-circle is called its *face*, and that part *within*, its *flank*.

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In Fig. 2 let AB represent part of the pitch-circle of a wheel upon which it is required to set out teeth in accordance with the principles laid down above. If upon the arc AB a circular template, E, is caused to roll, and this template is fitted with a tracing-point at *e*, then as the template rolls in the direction of the arrow the point will describe the curve *ebg*, and at each point in the curve its radius will be a straight line from the point of contact of the template E and pitch-circle AB, one of these radii being shown at *ce* in the diagram; this curve therefore fulfils the conditions required for the proper working of the tooth. In similar manner, if a circular template, F, is caused to roll upon the inside of the pitch-circle, and has a tracing-point in its circumference at *f*, it will draw the curve *gcf*, the radius of which also will be at any point a straight line drawn to the point of contact of the circles. Thus we have obtained one side of a tooth, *abgcd*, of which *bg* is the face and *gc* the flank; E and F are termed the *generating circles*, and AB the *base*. In mathematical language, the upper curve *ebg* is known as an epicycloid, and the lower, *gcf*, as a hypocycloid, and teeth thus set out are known as epicycloidal teeth. The same generating circle may be used for both face and flank of the teeth, but this is not necessary; but it is necessary that the faces of the teeth on one wheel shall be described by the same generating circle as the flanks of the teeth on the wheel working with it. If any number of wheels of different diameters are made, and the teeth on all of them are described by the same generating circle—both flanks and faces—these wheels will work promiscuously together, the teeth of any one of the wheels being suited to work with the teeth of any other of them. Before proceeding with the work of practically designing the wheels, I will describe another form of curve which also meets the required conditions, and which has some advantages in certain cases; they are called involute teeth, and their form is described by the unwinding of a thread from the circumference of a circle.

In Fig. 3 let A and B represent the pitch-circles of two wheels, of which the centres are at *c* and *d*, and let the dotted circles *klf* and *ehi*, drawn about the same centres, have their diameters in the same proportion to each other as are the diameters of the circles A and B. Join *cd*; then *g*, the point where the line *cd* cuts the circumferences of the circles A and B, will be their point of contact: *ef*, a line touching both circles *ehi* and *klf*, will pass through the point of contact, *g*. Let *u* be the end of the flexible line, *ueh*, wound round the circle *ehi*, and also let it indicate the end of another flexible line, *ufl*, wound round the circle *klf*, and at the ends of these lines describe respectively the tooth-edges *mm* and *nn*, touching at *u*. Because *en* is the radius of the curve *mm* at the point *u*, it is at right angles to it at that point; and because that is also the point of contact of the curves *mm* and *nn*, it is also at right angles to the curve *nn*; it also touches the point of contact *g* of the pitch-circles; therefore the involute curves *mm* and *nn* fulfil the conditions required for the edges of the teeth of wheels required for the proper working together of the wheels of which A and B are the pitch-circles. These teeth may be easily set out by means of a template, C, to which is attached by the screw *v* a spring, *vpr*: *opq* is an arc of the circle *ehi*, and the edge of the template C is made to exactly fit it, *t* being the centre. At *r* on the spring is fixed a tracer, by means of which the edge of a tooth, *rs*, is marked.

All the teeth of one wheel will, of course, be of one size and shape, and therefore a template having been made for one it can be used to mark them off all round the wheel.

The object of toothed wheels being usually to transmit work with certain modifications of speed and pressure, it will follow that two teeth in contact will be subjected to the same force, and will therefore require to be of the same strength and thickness; hence in a pair of wheels of different sizes the numbers of teeth on each will be proportional to their circumferences, and therefore to their diameters, and the number of rotations made by the wheels will be to each other in the inverse ratio of their diameters; for it is evident that if two discs are in contact, and the circumference of one is half that of the other, the former must turn round twice to pass over the circumference of the latter; and as the teeth cause the wheels to act in precisely the same way as if they turned by friction of their circumferences, the same will be true of toothed wheels; and, moreover, it is obvious that if one of two wheels has twice as many teeth as the other, the smaller wheel must revolve twice to engage with every tooth of the larger. So the rule for velocities of two wheels working together in gear is—*the numbers of revolutions per minute of the wheels are inversely as the diameters of their pitch-circles*, or *are inversely as the numbers of their teeth*. Thus, if a driving-wheel is 6 ft. in diameter, and the driven wheel is 4 ft., the speed of the driven wheel or *follower* is equal to that of the driver multiplied by its own diameter (or number of teeth), and divided by the diameter (or number of teeth) of the follower.

In a train of wheels the relative speeds of the shafts at each end of the machine—say, that of the last to that of the first or driving-shaft—will be found by multiplying together the numbers of teeth in the successive driving-wheels, then multiplying together the numbers of teeth in the followers, and dividing the former by the latter. For instance, let Fig. 4 represent a train of wheels, A being the driving-shaft, to which power is communicated through a crank, E.

Upon the shaft A is keyed a toothed wheel, *a*, working into a wheel, *b*, which, together with wheel *b'* is keyed on to shaft B; the wheel *b'* gears with wheel *c* on shaft C, on which is also fixed wheel *c'*, gearing with wheel *d*. The drivers in this train are *a*, *b'*, and *c'*, and the driven wheels or followers are *b*, *c*, and *d*. The number of revolutions per minute of the shaft A being given, the number for shaft D will be found by multiplying it successively by the diameters of *a*, *b*, and *c'*, and dividing the product by the diameters of *b*, *c*, and *d*. Let $a = 20$ in., $b = 45$ in., $b' = 25$ in., $c = 50$ in., $c' = 15$ in., and $d = 30$ in., and the number of revolutions of the shaft A = 60 per minute; then 60 multiplied by 20, by 25, and by 15 = 450,000; and this divided by 45, by 50, and by 30, gives $6\frac{2}{3}$ revolutions per minute as the velocity of the shaft D.

The proportioning of the teeth to the work to be done must now be considered, and this will be done on the supposition that the whole pressure transmitted by the wheel falls upon each tooth in succession, and so is entirely supported by one tooth. The tendency of the force will be to break the tooth off at the root like a bracket or beam-end projecting from a wall the same distance as the tooth from the rim of the wheel.

The strength of a tooth to resist fracture in cross-breaking varies as the square of its thickness, and simply as its breadth, and inversely as its length. If, then, all the dimensions are given in inches, its breadth multiplied by the square of its thickness and divided by its length, and the quotient multiplied by a constant according to the material used, will give its working pressure; or, putting it in a more convenient form for use, to find the thickness of tooth required, multiply the pressure in pounds upon it by the length of tooth, divide by the breadth of tooth and by 800, and take the square root of the quotient. This is based upon taking one-tenth of the breaking weight as the safe working load, for a tooth of good cast iron one inch in every direction will break with 8,000 lbs. at its extremity.

There are certain proportions of depth and other dimensions to the distance from centre to centre of the teeth—this distance being called the pitch of the teeth—that are found convenient in practice, and to these for all ordinary work it is best to keep. Calling the pitch 100, the dimensions are relatively as follows:—

Pitch of teeth	100
Depth	75
Working depth ...	70
Clearance at bottom ...	5
Thickness of teeth ...	45
Width of space... ...	55
Play	10
Length beyond pitch-line	35

Working with these proportions, a simpler rule can now be found for determining the thickness of the teeth. Divide the pressure upon the tooth by 480 times, the breadth in inches, the quotient will be the thickness in inches. Let a wheel be required to carry a force of 3,000 lbs., the breadth on the face of the wheel being 5 in.; then 3,000 divided by 480 times 5, gives $1\frac{1}{4}$ in. as the required thickness of tooth.

As in the table it appears that the pitch of the teeth should be to the thickness as 100 to 45, the pitch in this case will be $2\frac{7}{9}$ in., and the length or depth of the teeth $2\frac{1}{19}$ in., of which length one inch will be beyond the pitch-line. The pitch having been determined, the circumference of the pitch-circle must be made to fit it. Thus, suppose the smaller wheel of the pair required is desired to be about 3 feet in diameter, that would give a circumference of $3\frac{1}{7}$ multiplied by 3 ($3\frac{1}{7}$ being the ratio of the circumference of a circle to its diameter), equal to $9\frac{3}{7}$ feet or $113\frac{1}{7}$ in. This will not quite fit the pitch, allowing for a little more than 54 teeth; therefore it must be made for either 54 or 55 teeth. If the ratio of numbers of revolutions of the wheels is a whole number, it does not matter which number of teeth is taken; but if it is any fractional number, this must be considered in deciding upon the number of teeth to be adopted. Suppose, for instance, the pair of wheels is required to reduce the speed from 70 to 45 revolutions per minute; then the numbers of teeth in the wheels will be 54 and 84, which give the same ratio inverted. The strain on the teeth of the driven wheel will, of course, be the same as on those of the driver; but it will be greater on the teeth of wheel *b'* than on those of wheel *b*, in proportion as the radius of *b* is greater than that of *b'*. This follows from the law of the lever.

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It is a general law that, taking any two points in the machine, the pressures acting upon them will be in inverse proportion to the velocities of those points. To return to our example: if the wheel is to have 54 teeth, its circumference will practically be 112½ in., which is equal to $2\frac{1}{12}$ in. multiplied by 54; and multiplying by 7, and dividing the product by 22, the diameter corresponding to this circumference is found to be $35\frac{35}{44}$ in., which is very nearly $35\frac{13}{16}$ in. The circumference is spoken of as being *practically* 112½ in., because, strictly speaking, it is a trifle more; for, the pitch being measured from tooth to tooth in a straight line, it is a chord of the small arc of the pitch-circle between the centre of the teeth. It is practically of no consequence, as in the present case it would not make a difference of one-fortieth of an inch in the diameter.

THE ENGLISH LEVER WATCH.

BY A PRACTICAL HAND.

THE watch that holds its own the world over is made by the firm of Thos. Russell and Sons, Church Street, Liverpool. This watch, that has stood A 1 for such a long period, in fact, since they were first sent out by them—(this escapement was invented by Berthoud)—for accuracy combined with durability has no equal, the cases of 18-ct. or 9-ct. hall-marked gold or sterling silver, centre seconds, quarter seconds, and flyback seconds. The finest work are the £100 repeaters by the above firm—work that can be relied on. Seeing the amateur will have more sense than to meddle with last mentioned style of watches, I need not describe them; many in the trade cannot do this class of work, but place it in the hands of those who make it a speciality. The English lever, with a steel or gold balance, having the fuzee arrangement to equalise the power of the main spring, will, by careful regulation, keep correct time to about one minute a month; and the English-going barrel without fuzee will keep time to a minute or so a week; some may claim more, but I speak fair on the subject.

To clean an English lever, open the front dome, push out the joint pin from the 10 o'clock side of dial, and the movement is then free from the cases; prise off the minute and hour hands both at once, then carefully take off seconds hand; undo the cap and draw out the three pins holding dial; remove dial wheels, as described in Chap. II., unscrew cock of balance, and mark the tip end of hair spring on top plate for a guide in putting together again; draw out the pin and spring, and place under glass cover. Now proceed to let down the spring by placing the key firmly on square of ratchet (dial side), and prise out the click, keeping firm hold of the key; observe a dot on top of barrel arbor and a similar one on the bar: take note of this and the relative positions in resetting the main spring again.

Another way we practise in the trade, but too difficult for the amateur, is to remove the bar across the barrel, keeping firm hold in your left hand; put your thumb on the barrel, take up a small screwdriver, place it in the hole of the cover of the barrel, then press the barrel back until you can unhook the chain, using the thumb before mentioned as a brake to gently let down the barrel (easier said than done); now keep it upright in its place as well as you can, seeing it has only one side to work on: have no fear and you will do it easier. Now lift the spring free from the maintaining power, and all will be right. Withdraw the pins holding the top plate to pillars, raise top plate gently so as not to injure any pinion, more especially the lever; see that it does not drop out unnoticed, as it is liable to do so; lift it out with tweezers. Now notice the parts and the sketch engraved to this chapter, so that you may easily understand the replacing of same. Take out each wheel, and notice the maintaining power near fuzee wheel; do not

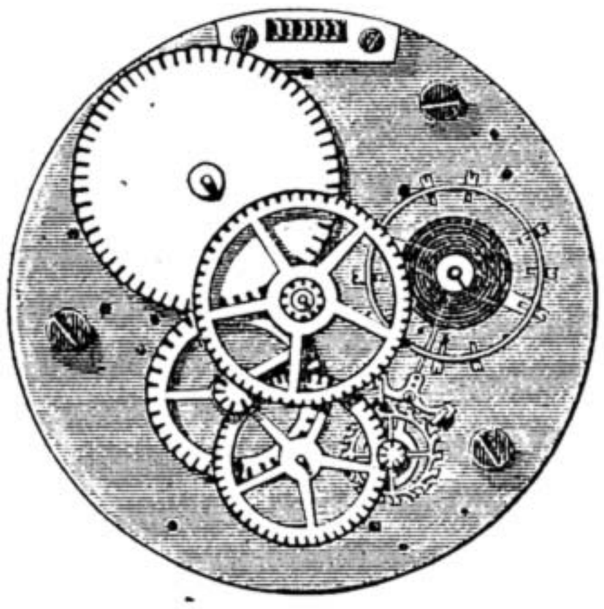

Fig. 1.—English Lever: Going Barrel.

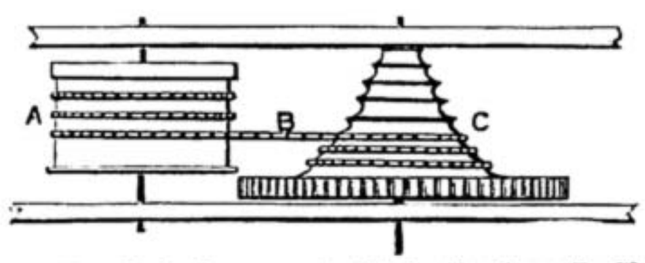

Fig. 2.—English Lever—A, Main Spring; B, Chain; C, Fuzee.

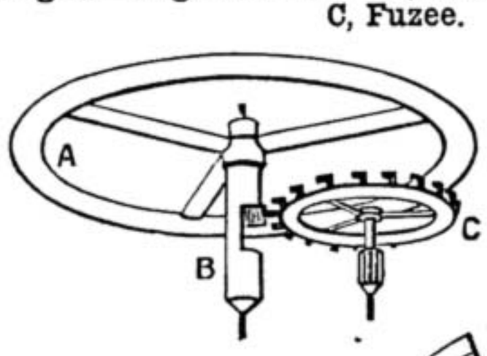

Fig. 3.
A, Balance.
B, Cylinder.
C, Escape Wheel.

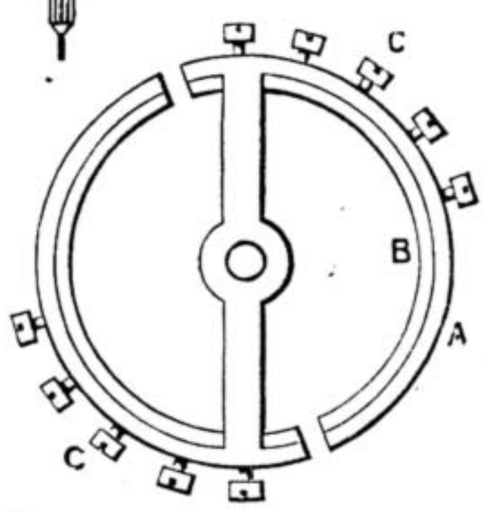

Fig. 4.—Compensation Balance.
A, Brass.
B, Steel.
C, Screws.

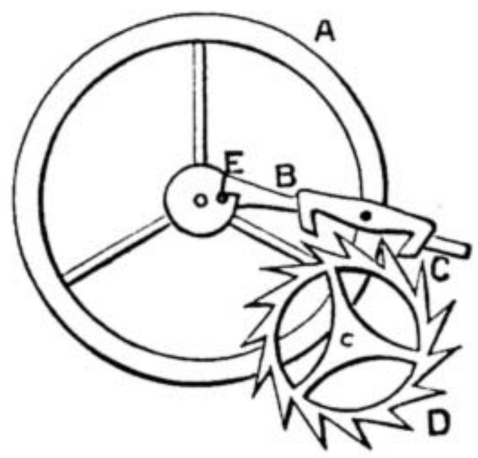

Fig. 5.—The Balance, etc.
A, Balance, etc.
B, Lever.
C, Pallets.
D, Escape Wheel.
E, Ruby Pin and Lever Notch.

lose it, as is too often the case. It is gone in many that come into my hands, and it must be through watchmakers' apprentices or careless men. The ratchet of main spring be careful to put away. Now clean plates, wheels, etc., as described in Chap. II.; hold every part in small squares of paper so as not to soil them in the slightest, the lever being better class work; tap the hair spring with the bristles of the brush, polish the steel or gold balance, peg-wood every pivot hole, and see no jewels are cracked or injured. A piece of clean cork cleans the pivots best, and in polishing plates, etc., keep the brush clean by drawing it over the prepared chalk. I would not recommend the main spring to be taken out and cleaned, but if you choose to do so, see previous chapter. All being clean and in good order, put in the third wheel, then centre wheel, next fuzee wheel and the maintaining power, then replace fourth wheel, and now the 'scape wheel; drop the least possible oil on the top fuzee pivot, place on the top plate, and press gently down, guiding each pivot. Having your eye-glass in position, examine if they all run clear and easy; if so, again gently raise top plate and replace lever pallets with the tweezers, bottom pivot first, and then press down top plate, and try if pallets move quickly by using moderate pressure on the fuzee wheel; now replace the barrel and its bars, of course holding the movement in clean paper; have its position so that the barrel is upwards and towards your right hand; now lift the hook end of the chain with tweezers and pass it under the pillar near the barrel and fuzee; hook it into its hole, which is near the small opening of the barrel cover. So guide the chain with your left thumb and gently wind with the key in your right hand until sufficient is only left under the pillar to hook it into its position on the fuzee part; next replace the small ratchet wheel, and set or turn the main spring up to the before-mentioned dots, which will be about half a turn; then oil the under plate, using very little oil, and slightly tip the pallet ends or two or three of the 'scape teeth; be sure not to use too much: this is the amateur's failing point. Now wind slowly up, guiding the chain into the grooves for the first time; unless you do so, it may miss, and so twist the chain that it will be permanently injured. Do not hurry over this or any part, in fact; some regular workmen will boast how quick they can take down, clean, and replace. Often these men have the work returned, and in the end it takes longer, besides annoying customer and master. Next oil all the top holes and replace balance, fixing hair spring to old position, as stated in former chapter; it should now be in full swing, with what we call a fine healthy beat; if not, some part is too tight or repair is needed. If so, see chapter to come on repairs, which will appear in due course.

If all right, try it under the glass cover four hours or so face downwards, and then if the beat is equal and all right, replace dial wheels, then dial, re-fix the three pins, and now replace the hands. Clean the cases well with rouge and chamois leather, and fit in the movement; push in the joint pin from 2 o'clock side, close up watch, and all is complete. Of course it will require regulating, as its going will be changed by the cleaning; move the regulator a very minute portion, using your eye-glass so as to have the greatest accuracy; it is worth the trouble. Many watchmakers only regulate them for hanging position in windows until called for, but they should be tried in several positions for good results.

AN ORNAMENTAL PLANT STAND.

BY CHAS. E. DODSLEY.

THE purpose of this paper is not to describe a plant stand which may be knocked together in a few minutes, but to show how, with a little care and at small cost, a stand for plants may be constructed—useful, ornamental, and unique—by any amateur in joinery, and, I venture to hope, be a new idea to some who are not amateurs. I take it that one of the primary aims readers of WORK, or, more properly, workers, should bear in mind is, "What is worth doing at all is worth doing well." To any who may

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be inclined to consider correctness in detail of secondary importance, the following stanza may be helpful :—

"In the elder days of art,
Builders wrought with utmost care
Each minute and inmost part;
For the gods see everywhere."

The stand as shown in Fig. 1 is similar to one I have had in use now for some twelve months. It has proved very useful, and, as now filled with well-grown ferns, is a graceful decoration to the room.

So much by way of preface. The plan is reduced to one-sixth. As will be seen, it consists of a framework made in two parts: the lower one 3 ft.; the upper 1 ft. 11 in. long; each about 2 ft. high. It is fastened throughout by mortise and tenon, glued. This frame supports three shelves; the lower one, an open board from end to end. This was suggested to me as an improvement, and will prove useful, my own having simply a rail in place of it. The two upper shelves are made of bars, or rails, as being lighter. The panels are of thin wood as used for fretwork, and may be either splashed work over leaves (this I will describe in its turn) or fretworked, as shown in plan. A general idea will be gathered from the foregoing: now to set about the making. In the first place, what wood shall be used? Preferably, either walnut or oak. From a board 4 ft. × 10 in., and when planed 1 in. thick, all the pieces required for the framework may be cut. Care must be taken that the wood is thoroughly dry and seasoned. Mark out, as shown in Fig. 5, the letters corresponding with those parts in the plan. It will be seen that, though the board is 10 in. broad, it is only cut into nine 1-in. pieces. This will allow of the saw-roughened edges being planed so as to measure just 1 in. square. If preferred, the wood may be got ready cut and planed; though I think it more satisfactory to do it oneself. It will be better to make the framework in two portions, making all joints to fit exactly, that the parts may be fixed together and taken apart again as the work proceeds. Take the eight pieces 2 ft. long × 1 in. × 1 in., which will form the uprights or legs, A, A, A, A, and F, F, F, F. These must each be fashioned separately, but may all be placed together and marked out at once. Fig. 4 shows the marking on the bar, each of the eight being alike. At the lower end make a tenon ½ in. deep, 1 in. long, × ⅜ in. thickness, taking care that each is cut with the grain and not across. Above this a square base 5 in. long, then 10½ in. to be formed into an octagon with equal sides. This will require to be done with a chamfer plane, the top and bottom being finished off with a chisel. Above the octagon, another square like the base, but 6½ in. Each of these squares will have two mortises to receive the side and end bars. The knob at the top gives a finish, and is easily shaped. Above the square mark a ½ in. space, leaving 1 in. to the top for the knob. On either side make two saw cuts across ¼ in. deep, and on the lines marking the ½ in. space; with a sharp chisel hollow out, leaving a neck ½ in. each side supporting a knob (as Fig. 3), with a square base, and a square cone with its apex cut off above. When the eight pieces are fashioned as described, take four of

Fig. 1.—Ornamental Plant Stand, drawn in Perspective on Scale of one-sixth, or 2 in. to 1 ft. Alternative Designs in Fretwork or Splashed Work over Leaves for Panels.

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them, and four pieces 7 in. long for bars, C, C, and staves, D, D; also two bars 2 ft. 11 in., B, B, for the sides. At each end of these pieces, with a fine saw, cut a tenon the same size as at the bottom of uprights—*i.e.*, full breadth of wood $\frac{3}{8}$ in. thick and $\frac{1}{2}$ in. deep. The mortises in uprights to receive these tenons will require to be 1 in. long, $\frac{3}{8}$ in. across, and $\frac{1}{2}$ in. deep. It is hardly necessary to say that the mortises should be cut just within the measurements of tenon they are to receive, so that when united a firm joint is formed. Much after-finishing and fitting may be avoided by taking pains that each measurement is exact; and all cuts, either with saw, chisel, or plane, cleanly done to measurements, this being insisted upon throughout.

The mortises in uprights must be made in proper order, or a hole in the wrong side will result. The easiest way is to first fit the staves and end bars. Take the uprights, and 2 in. above the tenon and parallel to it cut a mortise, and a second one in the top square $\frac{1}{2}$ in. above the octagon. Unite the staves and bars with the uprights, and thus form two ends. Place them opposite each other, and on the inner sides mark the position where the long bars, B, B, will fit in at right angles to the ends. When these mortises are cut, it will be found necessary to cut a square out of one of the tenons at either corner to fit as shown in Fig. 2. The shorter stand forming the upper part is united in the same manner; G, G, and H, H, being jointed into uprights; F, F, F, F, as described above, only in this case there are no staves. Care must be taken that the side bars in this case are fixed in the same line as tenons of the uprights, and the end bars at right angles.

It will be noticed that throughout the sizes of mortise and tenon are the same in each case. If desired, a square tenon might be made with $\frac{1}{2}$-in. side, but the size I have worked to entails less trouble, and if the mortises are carefully cut, is stronger and quite as neat.

For the feet take two blocks, E, E, and fashion them thus:—In each piece cut two mortises 6 in. apart, 1 in. from either end. Then 3 in. from the ends mark a line across, and from either side of the intermediate space cut a strip $\frac{3}{8}$ in. broad. From each of the four corners of the end pieces thus formed cut a triangular piece, the equal sides being $\frac{3}{8}$ in. Then from the upper edge plane a facet at an angle of 45° the whole way round. Fix the lower stand to the feet thus made; place the top half of stand in the position it will occupy, and mark exactly where the mortises must be made. By doing this a more correct fixing is secured, preventing the danger of any of the parts being thrown out of square when fixed.

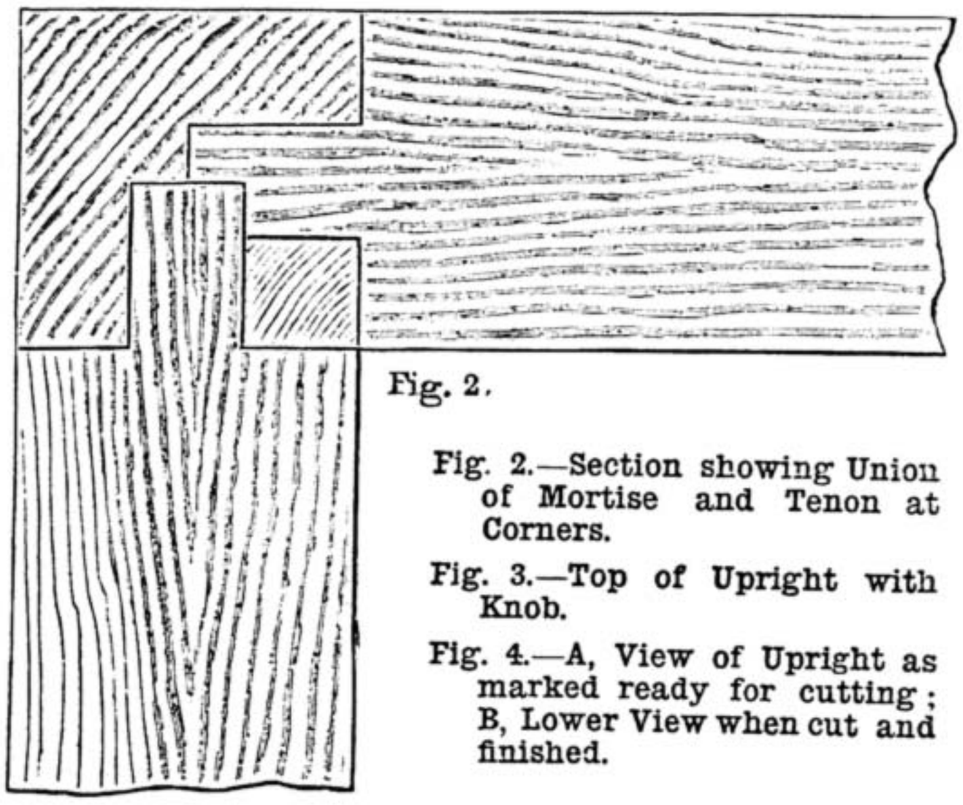

Fig. 2.

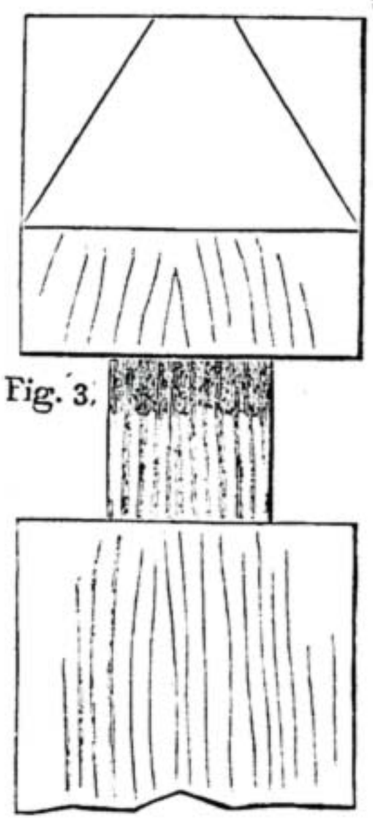

Fig. 3.

Fig. 2.—Section showing Union of Mortise and Tenon at Corners.

Fig. 3.—Top of Upright with Knob.

Fig. 4.—A, View of Upright as marked ready for cutting; B, Lower View when cut and finished.

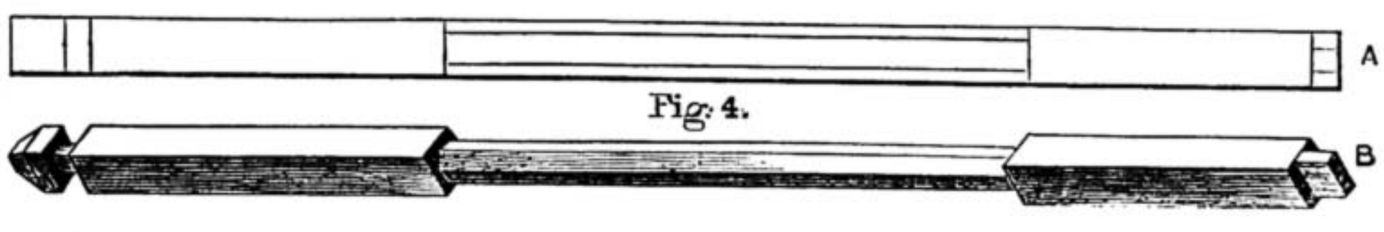

Fig. 4.

We have now in an unfinished state the principal part, in that upon it all the other depends; but without the remaining parts this would be of no use. If cost is to be curtailed, the bottom board may be of pine, stained; as it is below the level of the window, when in use not much of it will be seen. A board 2 ft. 11 in. × 8 in. × $\frac{1}{2}$ in. will allow of any shaped shelf being substituted the worker may desire for the one in the plan. At each end make two tenons 1 in. × $\frac{1}{2}$ in. × $\frac{1}{2}$ in., and 2 in. apart; then make mortises in each of the staves to correspond; that will leave 1 in. at each end of the staves. Lay the board flat, and at a distance of 4 in. from each end mark a transverse line. On each side within these lines cut off a piece 1 in. broad. We now have a board 2 ft. 10 in. long, each end 8 in. broad; the intermediate space 2 ft. 2 in., 6 in. broad. From each of the end oblongs, cut off a triangular piece, as was done with the feet, but now the equal sides being 1 in. Now fashion the length of each side edge with three facets of equal breadth. For the upper shelves six rails will be required, each 1 in. broad, $\frac{1}{2}$ in. in thickness; three for the lower shelf, 2 ft. 11 in. long; three for the upper one, 1 ft. 10 in. long. These are fixed into the end bars at an equal distance apart, leaving $\frac{3}{4}$ in. space between. In each of the end bars make three sockets, 1 in. × $\frac{1}{2}$ in. × $\frac{1}{2}$ in. and $\frac{3}{4}$ in. apart to receive the ends of rails. The brackets beneath the middle shelf are not absolutely necessary, but besides affording extra support and firmness, they give a finish to that part. The four brackets may be made from one of the pieces cut from the lower shelf. Cut four pieces each 4 in. × $\frac{1}{2}$ in. × $\frac{1}{2}$ in.; then take each one singly, and with a sharp knife or chisel, form an octagon in the centre $1\frac{3}{4}$ in. long; then make a mitred joint at each end. These brackets, if glued one end below the long bar, and the other to the leg, and firmly fastened with a long thin screw, add a graceful finish, and render the joints perfectly secure.

Now we come to that part which I always regard as the most tedious and troublesome—viz., smoothing with glass paper previous to polishing. It is well to have three sizes of glass paper handy, Nos. $1\frac{1}{2}$, 1, 0. First rub every piece smooth with No. 1; if any unevenness use $1\frac{1}{2}$ to rub down; then finish all off with the finest. Care must be exercised in smoothing edges and angles to avoid rounding the corners. The more pronounced the angles the greater the beauty of the whole when finished. It is unnecessary for me to describe the process of polishing. The pieces may be polished separately before being put together; and where polished pieces are to be glued, the polish lightly scraped off at the time. To put the stand together, first unite the two ends of lower part, securing them in the feet. Take the bottom board and two long side bars; fix them to one of the ends, and placing the other end in position a few sharp blows with a mallet will secure it. Unite the upper part in the same manner. It will be better to allow the glued joints to become quite set before fixing the upper part upon the lower, and then the brackets as before described; lastly, fixing the rails, which must be glued and secured with a screw at each end.

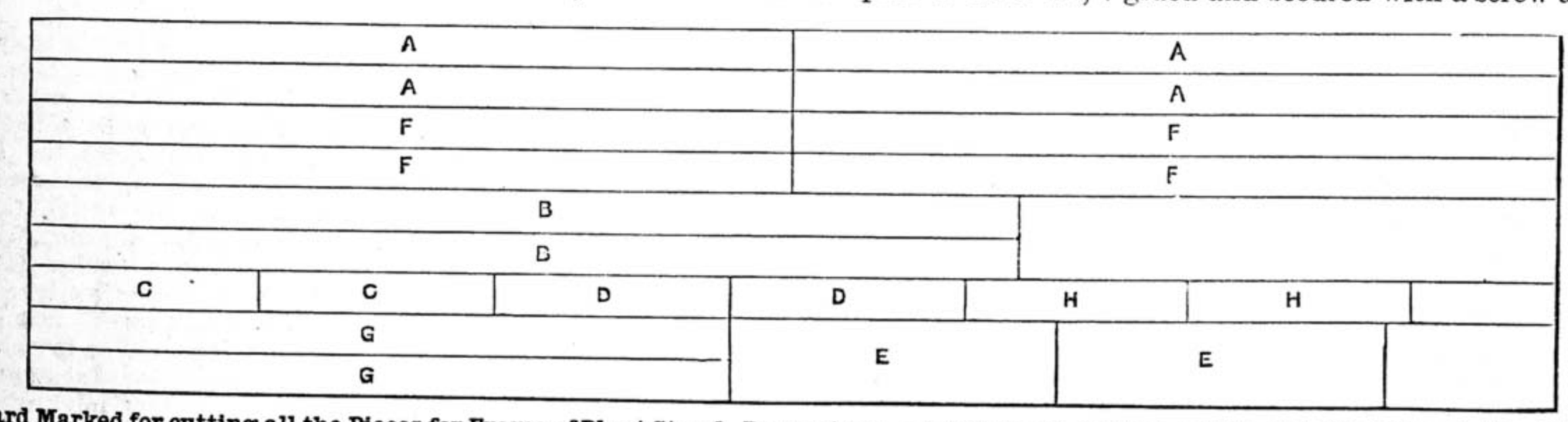

Fig. 5.—Board Marked for cutting all the Pieces for Frame of Plant Stand. Drawn to one-eighth Scale, or $1\frac{1}{2}$ in. to 1 ft. Length of Board, 4ft.; Breadth, 10 in.

If the plants have been waiting for a suitable stand, they may now be shown to full advantage, until the panels are made. The panels are of equal height, $5\frac{1}{2}$ in., and $\frac{1}{8}$ in. or $\frac{3}{16}$ in. in thickness. Twelve in all will be wanted as follows:—Four, each $5\frac{1}{2}$ in. long; four, each 6 in.; and four, each 1 ft. 9 in. If the frame is walnut, the panels will form a pretty contrast if made in oak, or *vice versâ*. Every one may not know how the splashed work mentioned in the earlier part of this

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paper is done. A number of small leaves will be required. Those which have a fine crenate or serrate margin, as rose or birch, or the pinnate fronds of ferns are the most suitable. They must be carefully pressed and dried previous to being used. The panel, being well smoothed with fine glass paper, should have a thin coat of linseed oil rubbed over and allowed to become quite dry. Lay the panel flat, and arrange the pressed leaves as desired, but not overlapping each other, and pin them in position. For splashing, a fine-tooth comb (horn will do) and a tooth brush will be necessary; also some burnt umber ground in water, and a little old beer or a weak solution of potash (about a teaspoonful of liquor of potash to an ounce of water), to mix the colour with. Take a little of the colour upon the brush, by dipping it first into the solution and then upon the colour; draw the comb lightly but quickly over the bristles, holding the brush almost perpendicularly so as to throw the splashes upon the board. It will be better to practise upon a piece of paper first, for the knack is easily acquired. Make the splashes thickest, and therefore darkest, over the leaves, shading lighter and lighter to the edges of panel. When quite dry a thin coat of pale varnish may be applied. If the frame be of oak or light wood, the panels may contrast in dark, in which case the splashing would not answer. If fret-worked, in which case more time would be required, each panel might be of a different design, or the long ones one, and the short ones another, as the worker may desire. I give (Fig. 1) a design such as is suitable for either of them. If the panels are made in fretwork, they should be carefully finished off and polished like the rest of the stand. The panels are fixed in slots, formed by fixing a narrow beading in front to the uprights at either end of the spaces, and a similar one at the back, allowing of the panel being easily slid in or out. The front beads should be just to the height of square—that is, 5 in., and flush with the edge. They are glued on, and fastened with very small brass or black nails.

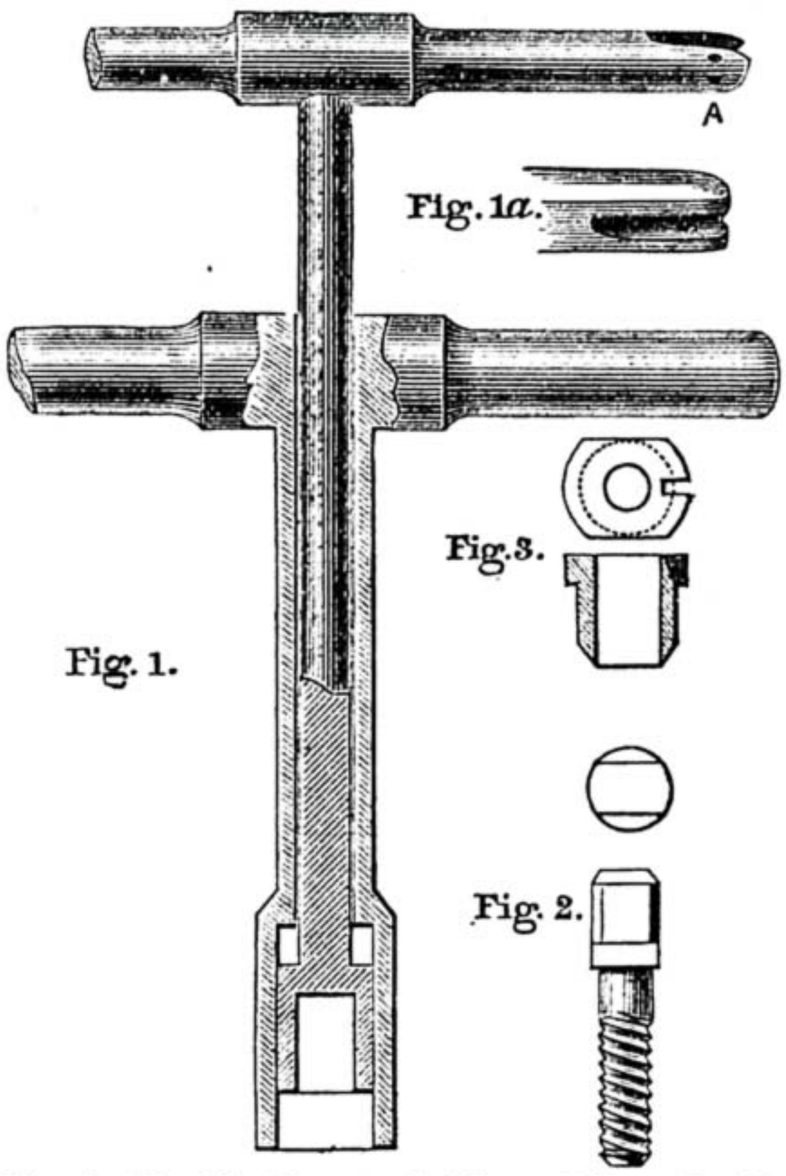

Fig. 1.—Double Key to fit Pin and Barrel with Provisions at End for Bending End of String to fit Barrel. Fig. 1*a*.—End, A, as seen from above. Fig. 2.—Screwed Pin with Left-hand Screw. Fig. 3.—Barrel with Notch for Strings.

OUR GUIDE TO GOOD THINGS.

*** *Patentees, manufacturers, and dealers generally are requested to send prospectuses, bills, etc., of their specialities in tools, machinery, and workshop appliances to the Editor of WORK for notice in "Our Guide to Good Things." It is desirable that specimens should be sent for examination and testing in all cases when this can be done without inconvenience. Specimens thus received will be returned at the earliest opportunity. It must be understood that everything which is noticed, is noticed on its merits only, and that, as it is in the power of any one who has a useful article for sale to obtain mention of it in this department of WORK without charge, the notices given partake in no way of the nature of advertisements.*

107.—SNAITH'S PATENT PIN AND BARREL FOR PIANOS.

MR. THOMAS SNAITH, Engineer, 20, Swarthmore Terrace, South Stockton-on-Tees, sends a model exhibiting the mode of appliance of his Patent Pin and Barrel for Pianos, and the Double Key that is used in order to screw down the pin and bring up the string to the required tension. Mr. Snaith regrets to say that he has not been able to induce pianoforte manufacturers to take to his invention. This, however, is no argument against its being a "good thing." The difficulty lies in the manipulation of the double key, which, to say the least of it, is very puzzling at first, because, in order to tighten the string, the outer key is used, and is turned one way, while, to fasten down the pin, the inner key is used, which is turned in the contrary direction. It took me some little time to comprehend and accomplish the working of the double key, but when this has been got over, facility in its use will soon be brought about by practice. The engravings show very clearly the nature and use of the pin, barrel, and double key. Fig. 1 shows the double key to fit pin and barrel. In this, as will be seen from the illustration, one key works within the other, the inner and smaller key fitting on and turning the screw shown in elevation and plan in Fig. 2, and which passes through the barrel shown also in plan and section in Fig. 3, this barrel being turned by the outer key, and, when turned, tightening the string or wire, the end of which is bent and fitted into a notch that appears on the right of both plan and section in Fig. 3. The right-hand end of the handle of the inner key in Fig. 1 is notched and perforated to afford ready means of bending the wire, as shown in the illustration. Fig. 1*a* is a view of this end of the handle seen from above. Fig. 4 shows the wrest plank with a barrel, A, and pin, B, in position. Fig. 5 shows a suitable form for wood uprights. Fig. 6 exhibits the arrangement of pins and barrels in wrest plank by means of a top view. When pin and barrel have been placed in position, as shown at B and A, Fig. 4, and the string has been properly attached to the barrel, the key is applied so that the outer part fits over the barrel, and the inner part over the pin. It will be noticed, on reference to Figs. 4 and 5, that the wrest pin is pierced to receive both pin and barrel, the conical end of the barrel fitting into the coned hole countersunk in the brass plate for the purpose of receiving it. The barrel moves freely in this conical depression, and is only fixed when the pin, which passes through it and enters a female screw below the hole countersunk for the barrel, is screwed down tightly upon it. Thus to tighten the string, the key is turned in the same direction as an ordinary pin, which slackens the screw with friction, so that there is only the stress of strings in turning. To join the barrel, the screw is turned in the opposite direction, so that the strain on strings has a tendency to tighten itself with the tapered cone on barrel. It will hold several times the weight that is required for pianoforte strings. The invention can be applied to iron frames as well as to wooden ones. Readers requiring further information, prices, etc., should apply to Mr. Snaith at the address given above.

Fig. 4.—Wrest Plank, with Pin and Barrel in Position.

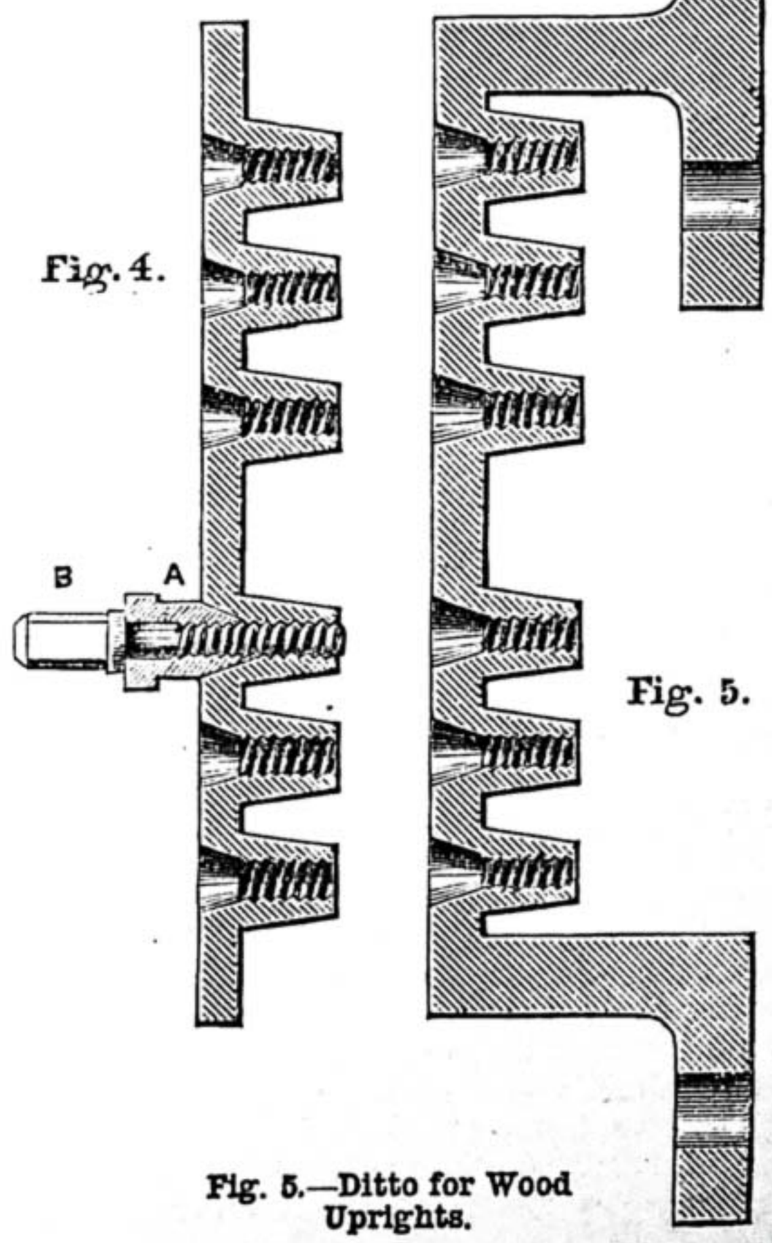

Fig. 5.—Ditto for Wood Uprights.

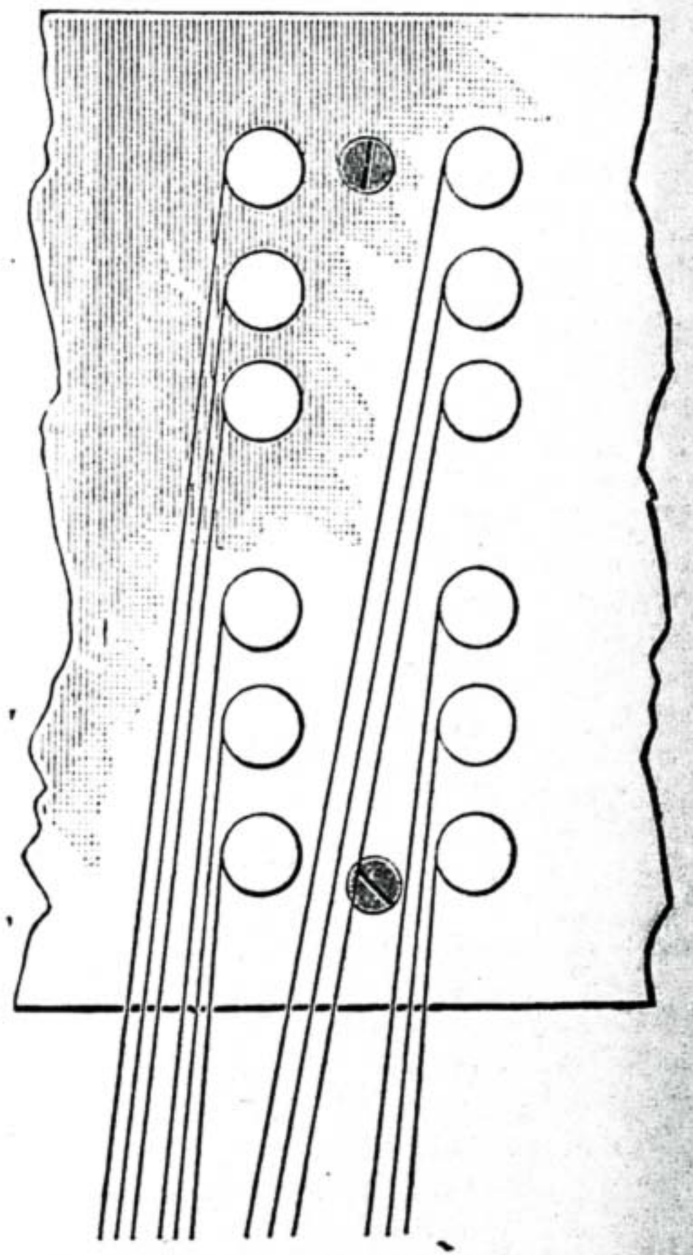

Fig. 6.—Front View of Wrest Plank, showing Arrangement of Pin and Barrels.

As I have just intimated, I do not know the prices put by Mr. Snaith on his pins and barrels in the first place, and on his double key in the second. In all novelties of this kind, involving a departure from the original mode of going to work and the nature of the appliances used, much depends on whether or not the new appliances are cheaper than the old; and cheapness, other things being equal, constitutes a powerful lever to raise them into favour. I fear, however, that the new pin and barrel, etc., are not cheap.

THE EDITOR.

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SHOP:

A Corner for Those who Want to Talk It.

*** Notice to Correspondents.—*In answering any of the "Questions submitted to Correspondents," or in referring to anything that has appeared in "Shop," writers are requested to refer to the number and page of number of* Work *in which the subject under consideration appeared, and to give the heading of the paragraph to which reference is made, and the initials and place of residence, or the nom-de-plume, of the writer by whom the question has been asked or to whom a reply has been already given. Answers cannot be given to questions which do not bear on subjects that fairly come within the scope of the Magazine.*

I.—Letters from Correspondents.

Pit Frame Saws.—Pit Frame writes in reply to G. W. (*Bournemouth*) (see Work, No. 21, page 322):—"No doubt you will be surprised at my not answering your queries before, but the fact is I have only just seen them in September's monthly part. If you will look at the title page, you will see for whom these articles are written. The frame described in No. 15 is capable of having large and heavy 4 and 6 in. tired wheels both for lorries and carts. We frequently make them upon ours. Yes, when having my holidays, I have been in good shops both in London, Edinburgh, Glasgow, and in large towns in England, and I have invariably found the frame described is fast superseding the pit. You ask, 'is it intended for amateurs or "pros," as not one in five hundred will undertake such laborious ill-paid work as wheeling.' Indeed, who makes the wheels then? You also say that 'French prepared wood, etc.' This is indeed news to me, as all the prepared wood I know of comes from America, large cargoes of boxes packed with machine-dressed spokes, naves, and even wheels. The set-stick is fixed at the front of the nave, and in the centre with set screw should work about stiffly. Small holes are bored every inch between half-way down the stick from the top. A piece of whalebone is plugged through so far as required for 'dishing' the wheel. The way of securing the nave does not weaken the frame in the least. Evidently you have never seen or used a frame like this before (hence the advantage of taking Work in), so please just make one and have it made strong, so that it will not spring at every blow, as you are afraid it will. You say you could send a sketch of a cheap, simple, secure fastening for nave. By all means please send it, as we are not above learning off brother workers, and I think it would have been better had you sent it at the first instead of querying. I don't know whether you are an amateur or a 'pro,' but I am sure that you must be clever when you made three carriage bodies (carriages not specified) 'with nothing but a piece of hand-saw.' Are you your own master, or were you working for someone? If your other tools are on a par with your piece of saw, I don't wonder at you being disgusted with wheeling, therefore I think the sooner you keep pace with the times the better."

Pen for Dotted Lines.—W. R. R. (*Carlisle*) writes:—"I notice in 'Shop,' Vol. I., No. 31, page 492, a very flattering mention of a pen for ruling dotted lines. Allow me to inform your correspondent, H. C. S. (*London, S.E.*), that he is very late in the field, as I have made and used such an invention for over ten years. Like your correspondent, I am in the same fix *re* 'patenting and its multitudinous costs.' I have several ideas and rough models of self-inking pens for artistic purposes and marginal work, only awaiting some enterprising firm to take them up. I, too, would be glad of your advice, which is of such sterling quality to amateurs. Work is one of the best and cheapest papers extant for assisting the youth of the country in this technical age."

Heating Soldering Irons.—C. P. (*Wanstead*) writes:—"Seeing in the 'Shop' column, page 494 of Work, a paragraph headed 'Heating Soldering Irons,' I should like to give my experience upon the use of oil stoves for that purpose. I had long wanted an oil stove for soldering with, as I have so many small jobs in the summer which are not worth while lighting a fire for, and cannot use gas without a little inconvenience. Having by me a stove called the Beatrice with 4 in. cotton, I thought I would try an experiment with it, so I took the tulk out in front, which left room for two irons to go through to the flame, but to my great surprise as soon as I lit it it began to smoke. I could not turn it up sufficiently to get my iron hot, and the light bobbed up and down, which I think was on account of the tulk being removed. Therefore I replaced the tulk in front and substituted a piece of strong wire twisted so as to hold the iron in place, and let it down from the top of stove nearly to the flame, and I find it answers very much better, but there is still room for improvement."

An Easily-Made Fret Machine.—W. R. S. (*Brixton*) writes in reply to One in a Fix (see page 492):—"No doubt some time before you see this you will have read my reply to Anxious and Mancuniam on this subject. I might add that if you live or are at any time near here (Brixton, the Editor has my address) I shall be pleased to show you the machine, from which I think you may get a better idea than from reading pages of instructions. Please let me know if there are any other points on which you require information, and also if you are successful, which I trust you will be."

Prize Competition.—The Editor of Work takes this opportunity to inform A. L. (*Hull*) and other readers of this Magazine that it was found impossible to give in No. 30 engravings of the prize bookcases that would be generally useful to workmen, and creditable as interpretations of the work of those who designed them. The designs with suitable descriptions will be issued in the course of the present volume.

Lathe for Wood.—H. A. (*London, E.C.*) writes:—"In No. 28 of Work, page 444, Stoker gives his opinion of Work, which I heartily endorse, and he tells us how he made, at a very small cost, a lathe for turning wood. I should be extremely obliged to Stoker if he would send particulars of that lathe. I have got a lathe wheel 21 inches in diameter, with crank, and a bit of a framework; it had originally been a jeweller's polishing lathe; the crank is about 16 inches long. If Stoker will kindly give me a few hints how to make it into a turning lathe, he will greatly oblige."

Pinhole Photography.—C. H. C. (*Strand, W.C.*) writes:—"I read with great interest an article in a recent number of Work on pinhole photography. I can add my testimony to that of the writer as to the clearness and good general effect of a photograph taken by this method, under favourable conditions. I recollect how much I was impressed once at a lecture given by Mr. Hepworth on elementary photography. Amongst others he showed on the screen (by limelight illumination) an image—at least 12 feet in diameter, I should think—projected from a slide of the usual size. The picture was of a statue; as far as I can recollect, of some great admiral, in one of our southern seaport towns. It came out beautifully clear, in spite of the loss that necessarily accompanies enlargement, and

I was never more surprised before than when I heard it was taken through a pinhole, the camera being an ordinary chimney-pot hat. I have only one suggestion to make; and that is, that better results, sharper images, etc., are obtained by having a hole perfectly clear from 'burr' round its edges. The writer recommends a visiting card as a good thing. A hole in such a surface, though, could scarcely be free from the above-mentioned defect. A better arrangement still, to the best of my belief, is that told me at a scientific society's meeting by a man who has practised the art a little. It is simply to substitute a thin sheet of copper, to repoussé a small part of it with a blunt point, and then finally make the hole in the thin part thus obtained with a fine pointed needle. The diagram which I append may possibly make things clearer.

II.—Questions Answered by Editor and Staff.

Saw Hammering.—T. O. (*Bootle*).—If any saw hammerer will make himself known to me, and offer to write on matters connected with his trade, I shall be pleased to arrange with him for such a paper as you require, but at present I am without a contributor on this subject, and am not acquainted with any one who could or would write on it. I am sincerely obliged to you for saying you would like Work to be twice the size and pay twice as much for it, but I fear all readers would not be of your opinion. It is true that there would be twice as much room for "Our Guide to Good Things" and "Shop," if the doubling system were entered on, but how about my time, which is pretty well taken up with Work as it is? Could you manage to insure me 120 minutes to the hour?

Turned Trellis Work.—H. C. T. (*Gateshead*).—On comparing the patterns of trellis work sent, you will see that they are so very much like those supplied by C. H. O., and have so much in common with them, that it will not be worth while to publish them in Work. C. H. O. explained that there could be but little divergence from the beaten track in this matter, and you will easily see this on consideration. As I have already explained, novel arrangements might be effected by the combination of blocks (*i.e.* flat pieces of wood in various shapes, such as triangles, squares, diamonds, hexagons, etc.) with turned spindles, but not with turned wood alone, at least I think not. When you have any decidedly original pattern let me have it, and I will publish it, and kindly let me have your name and full address that I may have it in my power to communicate with you if necessary.

Electric Pin.—H. E. (*Leicester*).—Those small scarf pin lamps are a speciality in incandescent lamps, and are sold under the names of "Gem" lamps and "Fairy" lamps. The lamps are lit with current from a small chloride of silver battery. If you can call on Messrs. T. Gent & Co., Braunstone Gate, Leicester, they will probably be able to show you one of the lamps, and instruct you how to fit it to a scarf pin. I see from their catalogue that they also sell a small lamp for special use in dentistry and surgery. I consider the chromic acid single-cell battery the most constant and powerful for your purpose in feeding a small lamp of from 2½ to 5 c.p. —G. E. B.

Alarm Contact for Mat.—A Subscriber (*Stalybridge*).—An illustrated description of door-mat contacts is given in my sixth article on Burglar Alarums. I think this will fully meet your requirements.—G. E. B.

Battery for Induction Coil.—J. Prince.—A pint Bunsen, bichromate, or chromic acid cell is quite large enough to work a coil 4½ in. long by 1¾ in. diameter. The number of cells required will depend upon the size of wire used in the primary coil. If No. 18 or 20, perhaps it will take two or three cells in series to fully develop the power of the coil.—G. E. B.

Tinsmith (*Great Grimsby*).—An article upon the construction of self-acting fountain is in hand, and will be published as soon as possible.—C. M. W.

Brazing and Coppersmith's Work.—J. A. (*Grimsby*).—Papers on these subjects will appear as soon as space and opportunity permit. Thanks for your good wishes.

Fronts for Bird Cages.—J. S. (*Coatbridge*).—I am not aware that fronts for bird cages are sold anywhere. At any rate I have never seen or heard of such an article being on sale. The material for cages, as far as wire is concerned, can be purchased, I should say, at any ironmonger's or wire worker's.—O. B.

Fixing Tortoiseshell.—W. J. M. (*Liverpool*).—Tortoiseshell can be fixed together by first filing the edges with a rasp, and then lapping one well over the other; you note that they are to lap, and are not to be placed with simply their edges touching. Then soften both the edges in boiling water, and when the surfaces are soft, place them together and grip them in the vice; but as you say it is for repairs that you want to know, I should advise you to be very careful how you apply the heat, or else you will find that your work has warped considerably.—H. S. G.

Ivory Stains.—W. J. M. (*Liverpool*).—Time stains can be taken out of ivory only if they are not very deep. You will have to remove the very outside of the surface with ground pumice stone and water; then place it in the sun under glass, and try that several times; then if it fails, try a wash of water, 10 parts, and nitric acid 1 part. There is yet another way used to bleach knife handles in Sheffield, where peroxide of hydrogen is the agent, but I don't know of this from any personal experience. If you have pumiced it, then to bring it back again to its former surface, rub it well with whiting and vinegar, or very weak vitriol and water and whiting.—H. S. G.

Soft Steel Solder.—W. J. M. (*Liverpool*).—Is it possible to soft solder steel? Of course it is, provided that you get your work perfectly clean—scraped clean I mean. Then brush the parts that are to come into contact over with chloride of zinc (perhaps you know it under one of these names—killed spirit, soldering solution, soldering acid, or soldering water, fake, etc.; there are any number of names given to it). After brushing it over with the solution, make it hot enough to drive off the moisture, taking care not to smoke, or in any way make the surfaces dirty; now, while it is hot, try and get your solder to hold on; if it will not, add a little Venice turpentine, and use the copper bit. It is a matter of proper application of heat and cleanliness chiefly. When you have it tinned all right, then tie your surfaces together, using a little Venice or solution as flux. Then blow at it, and add solder if necessary; if you do this you will be sure to get your work out all right and soundly soldered. Generally, merely brushing the surfaces with solution and drying them before tying them together goes all right, if your hands and all your soldering articles are clean and free from grease. I have found myself that it is best to use a spirit lamp instead of gas, it is so much cleaner.—H. S. G.

Loose Letters Tray.—G. H. P. (*Stourbridge*).—In reply to your query, the tray requires two pieces 2 and 2 A, two pieces 3. Each of these pairs to be cut in reverse—*i.e.*, one piece of each cut as the pattern, and one with the design reversed. One piece of Figs. 4 and 5. The reason why it is best to cut in reverse is that with a hand saw the two surfaces are not exact facsimiles, and therefore would show a right and wrong side in making up. If you use a machine saw the objection is less.—E. B. S.

Dimensions for Dulcimer.—J. A. (*Barrow-in-Furness*).—The dimensions for a D dulcimer, which is most suitable for playing with other instruments, are as follows:—Width at bottom, 2 ft. 10 in.; width at top, 1 ft. 4 in. Depth from back to front, 1 ft. 4 in. The best wood to use is beech for blocks and bridges, white or yellow pine for belly, redwood deal for back, braces, inside bridges, lining blocks, and top and bottom facings. Sound-hole frets are made of mahogany or any fancy wood.—R. F.

Parchment.—Drennan (*Kilmarnock*).—Before quoting the information relative to the supply of vegetable parchment, I wrote to Messrs. Barker and to Whiteley's, Westbourne Grove, who each quoted it to me as in ordinary sale. There should be no difficulty in procuring it. Wholesale chemists, I know, regularly supply it, and the jam-pot covers sold everywhere are a more common variety of the same stuff. It is so infinitely superior to any substitute that it is worth while to be quite sure where it can be easily bought, and if I succeed in purchasing any I will make the result public in these columns.—E. B. S.

Wax.—Constant Reader (*Manchester*).—Although unable to bring any special knowledge or experience to bear upon the question submitted, I am inclined to believe that if, as I understand your letter, the sample of German work sent is such as you wish to get yourself, some composition of the nature of plaster of Paris is that which you

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must fall back on. In the first place, the colouring process requires a white and absorbent article, otherwise you might experiment with celluloid. This is an ivory-like preparation by which paper, camphor, and acids produce a substance which can be moulded into the most delicate forms, becoming hard when cold. It can be made pliable by soaking in methylated spirit, and is highly inflammable. I think, however, you must try the former composition, and scarcely see why the wax and plaster will not hold together. Is the wax all right? Perhaps the plaster you use is too fine, and sets with too smooth a face, in which case mix a little fine sand to keep a rough face, and thus provide a grip for the wax. Plaster might work more easily if gauged with weak size-water: it would give more time for manipulating. Whiting mixed stiff with strong clear size might be useful, but mixed with glue would be too impure for your tints. I expect that material in general use for your purpose is some composition obtained by trade experiments and practical experience.—F. P.

Jeweller's Soldering.—W. J. L. (*Jersey*) wants to know what hard solder to use to solder a diamond in with, and what will prevent it burning.—For solder, ordinary silver solder will do very well. This he can buy at any jeweller's material shop or refiner's for about 3d. per pennyweight. He need have no fear of burning his diamond, if he carefully paints it over with borax (ground up with water on a clean piece of slate until it is as thick as cream). This being the flux for the solder, it can be applied with the camel-hair pencil at the same time that he places his pieces of solder on the work. Now apply heat enough to properly flush the solder. Never mind about the colour the diamond becomes, but on no account quench it suddenly. It must be left to cool by itself gradually. When it is cold it can be boiled out in "pickle" to get rid of the borax. The diamond will then appear just as it was originally—not damaged in any way, unless there should be a flaw in it. Then that might possibly cause a fracture, but I myself have put some dozens through the fire, and so far without accident—so much so that I should not at all hesitate in this case if I had to do it, so W. J. L. can go ahead without fear. See that your work and your solder is scraped clean, and that your borax is also clean. "Pickle" is about 1 part oil of vitriol (sulphuric acid) and 40 parts water.—H. S. G.

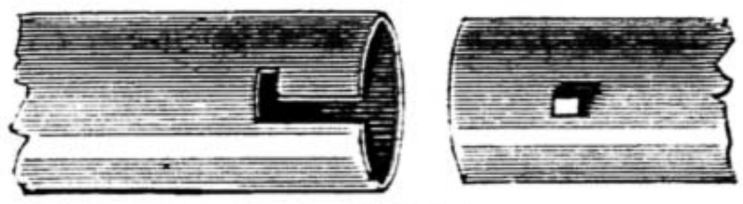
Desk.—W. H. (*Stockport*).—You ask for directions about making a good strong desk, but you have omitted to state the kind, so that I am unable to help you at present. Perhaps you are not aware that many different contrivances go by the name of desk. For example, there is the small portable form which folds up, and the large high clerk's desk. If you will be good enough to state your wants more fully, we will see what can be done to help you. Meanwhile it may interest you to know that papers on both the above-mentioned desks are on my list of subjects, and will be treated as soon as practicable.—D. A.

Camp Table.—J. A. B. (*West Ham*).—It is not possible to give the construction of a camp table within the limits of "Shop." It may be of some assistance to you to know that almost any table which can be folded may be roughly classed as a camp table. There are many arrangements by which the necessary portability can be attained. Perhaps the most general form is that in which the top is in two parts hinged together and attached to folding trestle legs. From the things you wish the table to hold I am by no means sure that you have not described it wrongly, and that what you really want is not a table but a stand of some kind. You might try Silver's in Cornhill, Pound's, or Goy's in Leadenhall Street. The work you name will receive due attention, but it is not so much required as some others which are of interest to the majority of readers. Ask anything you want to know about plumbing, and no doubt some member of the staff will be able to assist you.—D. A.

Bunsen Battery for Induction Coil.—V. R. (*Liverpool*).—(1) The break hammer for an induction coil 9 in. in length by 4 in. in diameter, with a core ¾ in. in diameter, may be made out of a disc of iron from ¼ to ½ in. in diameter, and ⅛ in. in thickness. This may be cut off the end of a soft iron rod with a hack saw, and riveted to the spring by means of a small brass rivet. (2) If you want a powerful battery to work the coil for two hours a day only, and then set it aside ready charged for the remainder of the twenty-four hours, do not use a Bunsen, which will require to be taken to pieces when done with, and set up again when wanted. Of course the same charge can be used several times if you follow the directions in my article on this subject. But I advise you to use a single fluid bichromate battery with lifting arrangements for the elements, as advised to J. R. for his electric light. Six cells would, I think, be too much for your coil. Try two at first, and increase the number if you require them. (3) ¾ in. is quite large enough for square of carbon. (4) Fill each cell to within ½ in. of the top. (5) Do not put any mercury in the porous cell with the carbon block. A little in the outer cell with the zinc is useful.—G. E. B.

Worms in Wood.—R. J. W. (*Norwich*).—These are difficult to eradicate sometimes as they often arise from the use of improper wood, or wood which has not been properly seasoned. In this case, as the cause lies within the wood it is constantly liable to bring forth more. The worms you refer to seem to be of unusually large size. Are you sure they are not the grubs of some moth which may have found their way in? The best way to eradicate vermin in woodwork is to wash it thoroughly with naphtha or benzine, the latter being, perhaps, the better of the two. Of course you must well saturate the infested parts, as mere superficial washing will not do. Other substances are sometimes used, but if you can't manage with one or other of those named, I am afraid you must give it up as a bad job, or else submit the chairs to an experienced cabinet maker. He would, probably, be able to detect the cause or kind of worm from slight indications which, if you are not a cabinet maker, it is easy to understand might escape your notice.—D. A.

Fishing Rod.—C. H. (*Stockport*).—I almost fancy that one of the Japanese so-called walking-stick fishing rods would suit your purpose. They are light, fairly strong, and very portable. Of course they are no use for large fish, but, from your asking about a bamboo fishing rod and stating that you take long walks, I suppose you want something which can be carried without inconvenience. No doubt you know that these rods are made of a kind of bamboo, and that the pieces being hollow they may be enclosed in each other, the thick or handle piece being the outermost. These rods can be bought for much less money than you could make one. To describe the construction of a bamboo rod such as you could make for yourself without much outlay would require more space



Bayonet Catch.

than can be devoted to the subject just now in "Shop," but the following few hints may be of assistance to you till the subject can be treated at length. The bamboo can be got from Mr. Westbury, Great Dover Street, Borough, London. Either one piece of suitable length must be got and cut into convenient pieces, or you can get several short pieces. Effect the connection by means of wooden pegs fitting tightly into corresponding pieces, if necessary binding the ends of the bamboo, to prevent it splitting, with fine brass wire or even waxed thread. You can also adopt the method of fastening the pieces together by means of a bayonet catch, which I think will be sufficiently explained by the diagram. This joint may be easily formed of thin brass tubing, and is suitable for rods of bamboo or solid wood.—D. A.

Book Backs.—R. M. (*Hyde Park, London*).—To repair the book which has the back off, proceed in the following manner. Take the book and gently strip off all the previous lining from the back, and wash the back with warm water until all the old glue is cleaned off. Procure two pieces of paper, for end paper to the book. They may be white or coloured according to fancy; cut them twice the size of the book, and fold in the centre. If coloured, the coloured side in; paste them down the fold with flour paste (using the fingers) about ¾ in. broad, and place them carefully on the book, the fold of the paper flush with the edge of the joint—*i.e.*, the risen-up part of the back of the book. Rub the paper well into the joint, taking care not to cut or tear it any way. When these have become dry put a nice coating of warm thin glue over the back of the book, and allow it to dry. Now get a piece of thin calico or muslin, cut it the length of the book, and about two inches broader. Glue the back again, and lay the cloth on, allowing it to come over equally on both sides. Leave aside to dry after rubbing well to insure the cloth sticking to the back. In the meantime take the back, or as it should be termed the case of the book, and clean off any torn or ragged bits of the old paper or lining still adhering to it. Now take the book and fit it into the case, taking care that the front of the case and book agree. This done, open one of the boards of the book, and with a paste brush paste the end paper and the piece of cloth overlapping from the back; shut the board, turn over the book, and repeat the pasting up on the other side. Put it into a press, or under heavy weights, until dry. If this has all been properly done the book will be as firm as ever it was. I have given the *modus operandi* for repairing a book in the condition assumed from your description. If I have omitted anything or misunderstood you, if you write again as explicitly as possible, I will be glad to help you still further. I would have liked to have known if your book is half bound or full bound in cloth or leather.—G. C.

Fret Machine.—G. W. J. (*Sheffield*).—As you are able to get a straight cut with large saws, I presume the machine itself is all right, for I daresay you are aware that the saw clamps sometimes need adjustment. Very small blades are always more difficult to work with than those of larger sizes. There is such a small amount of metal that any irregularity in the wood has a great tendency to deflect them. Possibly, though not probably, you have got hold of a bad lot of blades, some of which have an undoubted bias towards one side or the other. It is rarely, however, that you will find many in a batch which are defective, and I am inclined to think that your want of success is either owing to your not having sufficient experience to enable you to use very small blades, or what is much the same thing, to your having endeavoured to cut stuff which is too thick, and therefore unsuitable for them. Suppose you try cutting a piece of veneer with as little variety as possible in its texture. Saw across the grain, and see whether the cut is deflected. Are you quite sure that you feed the wood to saw direct without any lateral pressure, and that you have the right amount of tension? Unless you have this latter, which, of course, cannot be as great with a small blade as with a large one, you must not expect to be able to cut to a line whatever the size of the saw may be. If you are doubtful about the quality of the blades you are using, and like to enclose two or three of each size, I will test them on a thoroughly reliable machine, and say what I think of them, in these columns. If you are a beginner, let me, however, advise you not to use very fine blades, say, nothing under No. 1, yet awhile. With a No. 1 or 2 even the finest work can generally be done, and unless you are a thoroughly skilled worker it is a mistake to use the thinnest blades. Practical marqueterie cutters seldom do so. If you are trying them for inlay purposes, as I suppose you are, remember that thicker blades can be used, without the joints showing more, by increasing the tilt of the table. I hope these few hints may assist you, though it certainly would have been a guide to me in advising you if you had stated the thickness and kind of wood you have been trying to cut with Nos. 00 and 000. With regard to overcoming the noise of which you complain, I fear I cannot assist you. Machines with movable wooden arms are more noisy than those with perpendicular movement, and I think it very likely that the noise of yours is no more than might be expected. If it is a new machine it may work more quietly after it has been used for a time. Perhaps lubrication may lessen the noise, as it probably will if this is of a creaking kind. If it is merely what may be called rattling of the parts together, you must decide whether it is only natural to the machine or is caused by defective screwing up. Were I to hear the machine I could soon tell you, but as this is impossible do the next best thing, and get a machinist, or someone accustomed to fit machines, to test it. Before doing so, it will, of course, occur to you that very little machinery of any kind is absolutely noiseless.—D. A.

Medical Battery.—W. E. (*Bath*).—There is a great deal of delusion and misconception afloat just now respecting the properties and virtues of so-called medical batteries. As a fact, batteries in themselves have no effect whatever on the human frame, either curative or otherwise. It has been proved by Dr. W. Stone that the human body presents a resistance of 1320 ohms. Suppose, now, as you propose, we take a Leclanché battery of 40 cells, connected in series; the E.M.F. of each cell will be 1·60 volts, and the internal resistance of each cell will be 1·13 ohms. Now let us see what current you will be likely to get through your body by grasping the two poles of this large battery. We get the result by multiplying the voltage of each cell by the number of cells, and dividing this by all the resistances of the inner and the outer circuit. It stands thus:—

$$\frac{40 \times 1{\cdot}60 = 64 \text{ volts}}{40 \times 1{\cdot}13 + 1320 \text{ ohms}} = {\cdot}00468 \text{ ampères.}$$

I do not think this small quantity of current passing through your body can do you any good. The only result to you will be that you will be relieved of your surplus cash, for the battery will cost alone not less than £5. As you say that your purse is not a long one, in your interest I advise you to have nothing to do with medical batteries. Electricity can be applied as a remedial agent in some forms of disease, but its scope is very limited. When adopted as a remedial agent it is applied generally by means of the induction coil worked by a small battery, and this is named a medical coil, not a medical battery. It is sometimes useful in relieving neuralgic pains, in stimulating the nervous system deadened by partial paralysis, and in eliminating poisons from the body by electrolysis. If you will kindly tell me your ailments I will advise you with pleasure how to act to obtain relief, if electricity is needed at all.—G. E. B.

Gold Bath.—A. R. (*Ipswich*).—To get a uniformly rich deposit of gold from an electro-gilding solution, it should be maintained at a standard richness, which may be anything from 15 dwts. to 2 oz. of gold to the gallon of solution. That is to say, if 15 dwts. of gold to the gallon deposits gold of a sufficiently rich colour, we should be careful to maintain it at this standard by paying attention to its condition, and adding gold or cyanide as required to keep this quantity of gold in solution. I suspect your solution has been worked low in metal, hence the poor, light colour of the deposit. Renew it by adding more double cyanide of gold and potassium dissolved in distilled water, until it has recovered its proper richness. Exhausted solutions are best reduced by evaporation to a thick syrup, drying in a shallow dish on a sand bath, and subsequent fusion in a large crucible. The button and grains of gold thus obtained may be alloyed with any other metals held in the solution, and must be refined in the usual way to get pure gold.—G. E. B.

Steam Engines.—SCRUTINEER.—A high-pressure non-condensing steam engine discharges its

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exhaust steam into the air, or the chimney of the boiler—the steam escaping in puffs; in the condensing engine the steam passes into a condenser, and no escape is seen or heard; the engine will also be fitted with an air-pump. To measure the diameter of cylinder you must have the cover off and measure with inside callipers, or a gauge. The length of stroke you may get from the travel of the piston rod guide block.—F. C.

Hydraulic Engine.—SCRUTINEER.—You have made a mistake, there is no such term as "horse-power pressure." Nominal horse-power is not used in this connection. In no case can n.h.p. be determined unless dimensions are given.—F. C.

Banjo without Brackets.—ALPHA (*Birkenhead*).—In reply to your query for an idea for a banjo without brackets, I beg to inform you that nothing has been invented to equal brackets for stretching the vellum. I heard some time ago of a banjo without brackets, invented, I believe, by a gentleman in Liverpool, but I cannot give any particulars as to the working of it, further than every time the vellum wanted tightening it (the vellum) had to be wetted with a sponge. The very act of wetting the vellum after it was put on would (in my idea) condemn it. I have experimented in that direction myself, but I have not, up to the present, succeeded in making anything to answer so well as the brackets. Therefore, if you want to save time and money, etc., go to work with the brackets. I am sure nothing could look neater than well-made and nicely-plated brackets. The principal thing is to get good ones with a well-cut screw thread, common brackets being dear at any price.—J. G. W.

Lathe for Grinding.—J. J. P. (*Malton*).—Not knowing from your question whether you are an amateur or a workman, I must reply as to an amateur. You do not require a lathe of any special form for grinding, polishing, and scratch brushing; all you want is an ordinary (very ordinary) rough lathe; the grinding wheels, buffs, scratch brushes, etc., can be mounted on mandrel nose, or on iron mandrel to run between the centres. Don't do such work as this on a good lathe; the dust of it is ruin to any kind of machinery with nicely fitted slides and journals. You don't really need a complete lathe at all; if you have the bed, crank, wheel, and treadle, you can fit a pair of wood uprights for headstocks, with a pointed screw through each, pointing inwards, to act as dead centres; then have a number of mandrels, each carrying one or two grinding wheels or buffs to run between these points, being driven by a wooden pulley, which would be provided upon the end of each of the mandrels to receive the band from the fly wheel. Any lathe maker could fit you up a grinding lathe of this kind.—F. A. M.

Patent for Compounds.—L. M.—It is not advisable to sell the compounds until your patent is complete, though there is no law to prevent your doing so. You can drop the patent any time you like; you are not compelled to keep it up.—F. C.

Microscopes.—WATCHMAKER.—I would recommend you to procure a catalogue of a well-known optician. If it is not invidious, I would say that for your purpose you could not do better than to get one of Mr. Lancaster, optician, Colemore Row, Birmingham. As to the price of lenses, a cheap set can be bought for 3s. 6d., but an object lens of short focus and fine quality will run into pounds, but the price of various qualities and powers will be found in any optician's catalogue. As to fitting the cell into the power-tube, if the said tubes were sent to Mr. Lancaster with instructions, it would be most courteously attended to—at least this has been my experience. He has done a good deal of such like work for me from time to time, and I have always found him kind, and his charges exceedingly moderate.—O. B.

Tondeur Photographic Developer.—E. L. H.—The formula for tondeur developer is a private formula, and unknown except to the compounders. If in one solution, the probability is that it is a hydroquinone developer, but without further information it is impossible to say.

Camera Bellows.—JACK OF ALL TRADES.—Several dealers supply parts of cameras. Mr. Tyler, of 58, High Street, Aston, Birmingham, will forward a price list on application.

Cost of Materials and Tools for Camera.—H. J.—The tools requisite are ordinary cabinet-making tools. The following list will be found sufficient: Tenon saw, planes, chisels, screwdrivers, drill, hammer, square, gimlet, and compasses. It is not the tools, but the manner in which they are used. A fit-out of cabinet-maker's tools varies from a few pounds to a few hundreds—there is no limit. As a workman gains in experience, he not only finds the advantage of a variety of pattern tools, but frequently designs special ones for the job he has in hand. It is bad policy to purchase new low-priced tools. Good second-hand ones, chosen with discretion, is probably the least expensive way of getting an outfit. Cheap or low-priced tools are generally deficient in temper, and are altogether a bad investment. The wood can be obtained of most timber merchants, and the metal work from Mr. Tyler, 58, High Street, Aston, Birmingham. Other dealers in photographic requisites also supply fittings. Obtain price list. Cost of completed articles probably two or three pounds; one from the regular makers eight or nine.

Engine with Oscillating Cylinder Callipers.—I think, if you wish to make an engine with oscillating cylinder, and do not know how to arrange the steam passages, you should get a book which treats on the subject, and so obtain more information than can well be given in "Shop" in answer to a query. You might get Powell's book from your nearest bookseller, or you might send 1s. to T. E. Hallewell, 50, Hanover Street, Dantzic Street, Manchester, and ask him to send his working drawing of oscillating engine. If you like it, you can afterwards get a set of castings for 5s. It is almost a pity to make a 1 in. cylinder without a slide valve, and I am afraid a slight sketch such as you ask for might not enlighten you much. The usual plan followed in small model oscillating engines is shown at Figs. 1 and 2. Fig. 1 represents the flange on the side of a double-acting cylinder; the face, A, is got up perfectly flat and parallel with the bore in the cylinder; port holes, *a* and *b*, are drilled leading to top and bottom of the

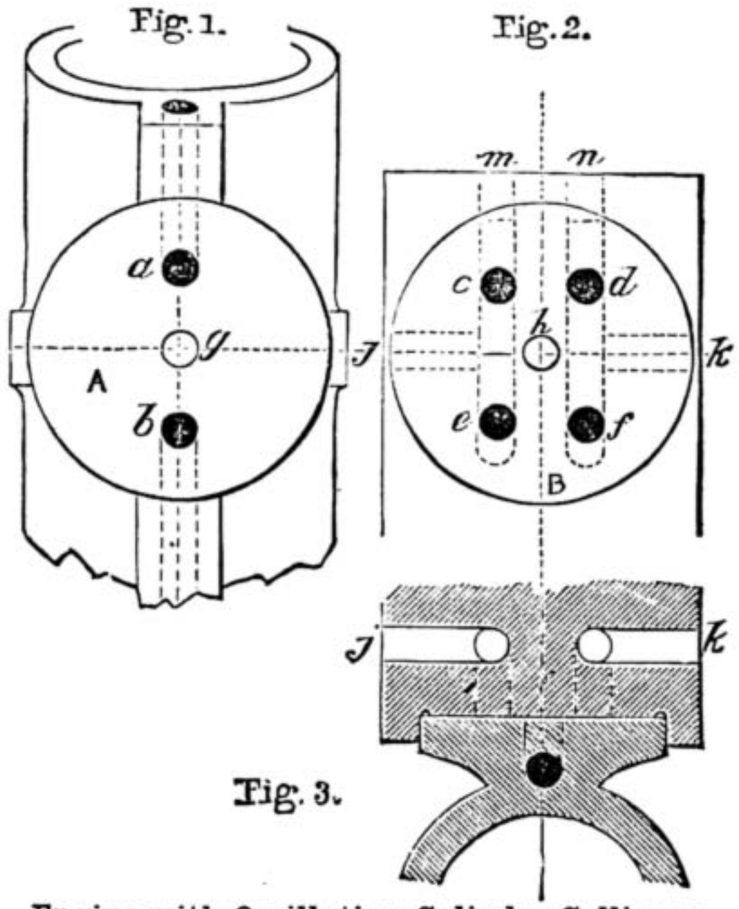

Fig. 3.

Engine with Oscillating Cylinder Callipers.

cylinder; also central hole, *g*, to fit the point, *h*, on which cylinder rocks, and which is certain to wear the hole larger and work loose. Now, if the face, A, be brought round and laid on face, B, the ports, *a*, *b*, will come exactly between *c*, *d*, and *e*, *f*, the cylinder being upright; this is the dead point when no steam passes. If *j* be the steam entrance and *k* the exhaust, then *c* and *e* will be steam ports and *d* and *f* exhaust; therefore, if the top of the cylinder swings to the left port, *a* will come over *c* and send steam to the top of the cylinder, whilst port *b* would come over *f* and allow the bottom of cylinder to exhaust. *m* and *n* are holes drilled down to meet the four portways, and are plugged at the top. I would not trust to the point *h* to support the cylinder, unless it were but $\frac{3}{16}$ in. diameter, but would sink the surface, B, about $\frac{1}{8}$ in., and turn the edge of the flange, A, to fit into the recess, as shown in the sectional plan, Fig. 3.—F. A. M.

Camera Bellows and Lens.—J. S. (*Dudley*) had better write for a price list to Mr. Tyler, 58, High Street, Aston, Birmingham. There is no lens specified. If J. S. would practise folding with a piece of paper, he would find bellows making very easy as soon as the knack was acquired.

Proportions of Quarter Plate and Whole Plate Camera.—G. S.—If G. S. will carefully read the article in question, he will see that "principal measurements" are mentioned, which is intended to mean that the frame of the body, the focussing screen, and dark slide must be made to work $4\frac{1}{4}$ by $3\frac{1}{4}$ plates, which is a fourth of the whole plate. The substance of the material may be to the taste of the maker. It is of very little consequence, so long as the inside measurements are right. Old-fashioned cameras used to be much larger and heavier than modern ones. It goes without saying that a small instrument does not require the same amount of strength as a large one. A clever workman will simplify whenever he can do so without interfering with the working capabilities—in fact, brains must be used.

Simple Lathe.—WELL-WISHER.—As you think you could make the lathe described in No. 17 by me, I would strongly advise you to do so, especially as you mean to learn the art of turning upon it. The simpler lathe to which I there referred is that known as a pole lathe, which is a sort justly going to the background. I trust in Part 3 of the series "Lathes for Everybody" to describe a unique lathe, which ought to be a great convenience to those amateurs whose space is very limited. I am glad to hear of your hopes. It brings so strongly to my mind what I felt when I began mechanics. I will be most happy to give you the right hand of fellowship in everything, and trust you will turn out, like me, a SELF-HELPER.

Banjo Making.—DARKIE.—In reply to your request for an article on banjo making, I am quite willing to do my best to oblige you in that direction, provided the Editor is agreeable, and can find room for it.—J. G. W.—[The Editor is agreeable, and will *make* room for it.—ED.]

Second-hand Headstocks, etc.—F. H. N. (*Malvern Wells*).—You can manage in either of two ways: by applying to second-hand dealers in machinery, or by advertisement. If you have plenty of time, go to the dealers in Worcester, or, better still, Birmingham, and suit yourself. If not, try an advertisement in the *Exchange and Mart*. The difficulty here is that the reply may come from so far off that you cannot go to see before you buy; but this is partly overcome by the system of deposit, whereby the price is sent to the manager of the paper, and held by him till the buyer is satisfied, or has returned the goods as unsuitable, when the money is forwarded or returned accordingly. You can easily find out second-hand dealers by inquiry at different hardware shops.—F. A. M.

Moulding Papier-Mâché.—C. H. C. (*Hornsey*).—The method of forming papier-mâché ornaments from pulp with which we are familiar is by using iron moulds, and subjecting the material to considerable pressure. Probably C. H. C. might do well to place himself in communication with the Papier-Mâché Company, London, whose work lies in this direction, and ascertain the process employed by them. We have not their full address to hand, but a Directory will supply it.—S. W.

Cutting Paper Tubes for Boxes.—KROW (*Glasgow*) has doubtless discovered ere this that his query has been answered. We would remind him that some time must necessarily intervene between the receipt of a question and the appearance of its answer in "Shop."—S. W.

Black Japan Varnish.—PAPIER-MÂCHÉ.—Some preparation of Brunswick black has probably been palmed on F. M. instead of the proper article. "Japan" is a word often used by manufacturers to convey the idea of blackness and brilliancy, as in "Japan blacking." He should apply to S. Thornley, 6, Snow Hill, Birmingham, stating the purpose for which the "black japan" is required, and he will get the proper thing.—S. W.

Battery for Electric Light.—H. A. T. (*Bermondsey*).—Your battery is a single fluid chromic acid battery. Charge the cells with a liquid composed of 1 lb. of chromic acid and 2 oz. of chlorate of potash dissolved in 1 quart of warm water; then add to it 7 oz. of sulphuric acid. Allow this to get cool before charging the cell.—G. E. B.

Statical Electric Machine.—W. M. (*Liscard*).—A description of a statical electric machine would be far too long to be printed in "Shop," and would be almost useless apart from drawings illustrating each part. A series of illustrated articles on this subject will be given in WORK at some future time, but I must ask you to possess your soul in patience whilst waiting for the good time coming, since our "Shop" is now very full of work, and WORK is in danger of being filled with "Shop."—G. E. B.

Electric Belt Links.—TINMAN (*Homerton*).—Cut the links out of 24-gauge copper and zinc plates. The zinc lozenges should be plain oval pieces with a small transverse slit in each end. The copper lozenges should have a small tong or projection at each end, and these tongs must pass through the slits in the zinc lozenges, and then bent back to form a closed hook. The ends of these hooks may be soft soldered, but I do not think this necessary, as there will be no strain upon them when sewn into the flannel. I verily believe you would get as much benefit from wearing a piece of clock chain, or a piece of iron chain, inside a flannel belt, as you will from one of those galvanic chains. You will get more benefit from wearing a simple belt of new flannel than all these quack remedies put together. If you can tell me exactly what you want with such a belt, and what you hope for from it, I will give you some valuable advice from my own long experience. These advertisements are a delusion and a snare.—G. E. B.

Polishing.—M. J. (*Glasgow*).—The piece of work you name may as well be French polished, though if you prefer you may either wax or oil polish. The first-named method will give the highest gloss, and I shall confine my remarks to it. The mahogany you are using being old may be dark enough, but if not you can use a little stain. Oiling will, however, probably be sufficient. Use raw linseed oil, and apply it with a rag, rubbing it well in, and then letting the work stand for a day or two. Then stop the grain with a mixture of fine whiting, turpentine, and a little rose pink for colouring. Rub this well in with a rag, and clean off the surface before the composition gets hard. The wood is then ready for the polish. This you can make yourself, but it can be bought as cheaply. To use it, get some cotton wool or wadding and a piece of soft rag. Moisten the wool with the polish, and wrap it in the rag, taking care that there is only one fold of this between the wool and the wood. Avoid creases on the rubber where it comes in contact with the wood, or you will not get a good finish. The rubber being ready, touch the face of it with a very small quantity of oil, the smaller the better, just enough to make it work smoothly. The wood is then to be gone over with this rubber till there is a sufficient body of polish on it. This you can only learn by experience, but it may be a guide for you to say that the rubbing is continued till the wood has a polish on it, but only a smeary-looking one. After you have got a

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body on, let the job stand over, and if the polish seems to go or be absorbed after, say, a couple of days, repeat the bodying process. The smears are removed, and the final polish is got by "spiriting off," that is, using a similar rubber to that already described, but without any of the oil and French polish, for which methylated spirit is substituted. In doing this you will have to be very careful not to "spirit off" the body you have previously laid. Continue rubbing till you have sufficient gloss. Such in brief is the process which will be described at length in a series of exhaustive papers on polishing of various kinds as soon as practicable. You will find that the rubber cannot be effectively used on carved parts, which you had better finish with spirit varnish. Paint it on with a brush, and be careful not to lay it on too thickly, or you will get a coarse effect. You are, doubtless, aware that a very good appearance may be got by simply polishing the plain uncarved parts, and leaving the carved work dead by merely oiling it. This is a plan which, as a matter of taste, I should adopt.—D. A.

Aquarium Glass.—AQUARIUM (*Canning Town*).—For the glass for an aquarium 16 by 13 by 14 inches, you had better use what is known in the trade as "32 oz. sheet." For cement for the same see reply to TYRO, page 221.—C. M. W.

Fountain Aquarium. — OUVRIER (*Birmingham*).—The construction of an aquarium with an automatic fountain combined is quite within the reach of any one capable of doing ordinary sheet metal work, and a fully-illustrated article upon the subject appeared in No. 31 of WORK, page 481.—C. M. W.

Safety Cages.—E. J. J. (*Notting Hill Gate*).—There are several inventions patented and in use to arrest the fall of cages in coal and other mines, and in cases where the rope breaks; also similar appliances for securing the safety of passengers in warehouse lifts. There is a very effective arrangement of this kind on the Otis lifts in the Eiffel Tower.—F. C.

What to Turn.—CAR (*Carmarthen*).—You have a Milnes' 5-in. lathe with slide rest and tools for wood and metal, also a good set of chucks and a circular saw and table—a very good set of tools let me say—and you wish for patterns, etc., of articles which you can turn. Now with such a good outfit you can make a great many things in wood and metal, but as you are a beginner, begin with wood, and learn to turn in soft wood and hard, laying aside the slide rest and metal-turning tools for awhile. You can hardly do better than begin with tool handles; then go on to boxes which have two parts to fit together, and require to be hollowed out; flat boxes and taller and deeper match-boxes, egg-shaped boxes to hold thimbles, etc.; then make some wooden candlesticks—small ones for wax tapers and large, tall ones. All these things are excellent practice. You might try some Egyptian trellis (see No. 7 of WORK)—very good practice: see also page 281 of No. 18. Holtzapffel's Vol. IV. is a most admirable book, and has many excellent designs.—F. A. M.

Choice of Lathe.—MEDUSA (*Leith*).—You ask advice as to your choice of a lathe for small metal work, including milling, and you mention the Britannia Co.'s No. 14, Barnes' 5½ in., and Price's Universal, which have all been noticed in WORK. Now these are all very good lathes, and it is, of course, a matter of opinion as to which is best, but if you want to do milling I must say that I should in your place go in for Price's lathe with the vertical slide. I would have a long leading screw, a clamp to fix the vertical slide at any height, a bored mandrel, and would ask them to increase the length of the front slide to give more bearing surface.—F. A. M.

Small Motor for Lathe and Sewing Machine.—J. B. (*Keighley*).—An electric motor will do what you want if you have the supply of electricity; if not, you would want a battery, which is far too costly to supply with zinc and acid to answer your purpose. If you can get water from the town main at 9d. per 1,000 gallons, and at 100 lb. pressure per square inch, you might use a "Thirlmere" wheel water motor, which is very cheap, and far the most convenient thing to have, but the water will cost a shilling or two per day. You might have a one-man gas engine, sometimes to be got second-hand for £10, but don't have it in a living room, as it thumps and smells. The gas for this costs a mere trifle.—F. A. M.

"Royal Mail" Cart.—PARENT (*Amen Corner, London*).—A paper on how to construct one of these popular carts for children is given in No. 30.—ED.

Watch and Clock Making.—GOVAN.—These papers were commenced in No. 20 of WORK, published August 3rd last.

Smithing.—I am in receipt of your letter with reference to smithing, and am pleased to find that the papers thereon give you satisfaction. They will be resumed in a very short time, and will include every branch of the trade.

Verge Watch.—W. B. (*Tipton*).—The paper on this subject will have met your eye long before it can light on this reply to your remarks on this subject. It by no means follows that because the first of a series of papers is commenced in any particular number that the second will of necessity appear in the number immediately following. Rest assured that there are always good reasons for doing all that is done in this way, but to give detailed explanation as to the why and the wherefore of the doing to all who ask it is neither necessary nor expedient.

Bookbinding.—BOOKBINDER.—The papers on bookbinding will be commenced very shortly, but I cannot name any precise time. It will not, however, be long now before a beginning is made. I am obliged to you for your good wishes and good opinion of the Magazine as it is.

Modelling in Wax.—WAX.—It will not be possible to give, at all events at present, any description of the methods of preparing anatomical subjects and facsimiles of natural objects in wax. Although it is sought to do as much as is practicable in WORK, still it is beyond my powers to take up every point in the great circle of the sciences as they at present exist.

American Organ.—WAX.—Instructions in building organs of this class will be given as soon as opportunity offers, but to go through every instrument of the kind from the barrel organ of the streets to church organs, and "also the kind to be seen at shows known as military organs," is utterly beyond my power and the purpose of WORK. The use of technical terms in WORK cannot be given up. Ask the meaning of any term that you do not understand.

Wood Screw Cutting Tool.—J. H. E. (*Shepherd's Bush*).—It has been already stated in "Shop" that the London agents for the sale of the specialities of Messrs. Peugeot Frères are Messrs. Alexander von Glehn & Co., 7, Idol Lane, London, E.C., but this, doubtless, has escaped your notice.

Index to Weekly Numbers of WORK.—N. W. C. (*Manchester*).—The addition of an index to the contents of each weekly number of WORK is under consideration, but no change in the present form can well be made until the commencement of Vol. II., when, in all probability, many improvements will be effected. A. E. W. and MARKET WEIGHTON are referred to the above reply as an answer to their letters on this subject.

Index to WORK.—ALARUM.—An index will be prepared for each volume of WORK. I am glad to find that you are among the many who have derived benefit from the Magazine.

III.—QUESTIONS SUBMITTED TO CORRESPONDENTS.

Battlesden Cart.—R. B. (*Fife*) writes:—"Would HOMESPUN (*Tenterden*) give instructions for making wheels for Battlesden cart (see page 524)?"

Carving Woods and Patterns.—J. D. (*Broomhill*) writes:—"Where can different woods for carving be obtained? Also is there any one who enlarges designs according to patterns that may be sent, and from whom models may be hired at a charge per month?"

Terra-Cotta, Monumental, and Portrait Painting.—PIXIE (*Aberdeen*) writes:—"Would you kindly allow me a small space in 'Shop' of WORK to ask if any of the readers or your staff would kindly oblige me with an idea of how to do any of the below-named subjects:—1. A practical treatise on the manufacture of bricks, tiles, and terra cotta? [We cannot teach you how to write a popular treatise.—ED.] 2. How to hang the drapery on an urn for monumental stone-cutting, with a few sketches of the same? 3. How a portrait is painted? And for certain it would do good to more than me."

IV.—QUESTIONS ANSWERED BY CORRESPONDENTS.

Pill Making.—PHARMACIST (*Kingstown*) writes in reply to J. C. (*Carlisle*) (see No. 31 of WORK, page 494):—"If J. C. (*Carlisle*) were to apply to Messrs. Maw, Son, & Thompson, 11, Aldersgate Street, London, they would gladly submit prices, and supply any article or machine used in pill making. There are various forms of pill-making machines in the market, and I feel certain that if J. C. were to call upon any of the chemists in or around Carlisle during their quietest time they would willingly let him see the various forms of pill tiles, rollers, coaters, silverers, etc. He would then be in a position to describe the kind he would require. An ordinary mahogany frame pill machine to roll and cut 24 pills at a time would cost from about £1 to £4, according to fittings. A Pindar's rotary pill machine would cost from 12 to 30 guineas, according to requirements. Graduated pill tiles may be had from 6d. upwards. When only a small quantity of pills have to be made, the simplest method is to weigh out a given quantity of the pill mass, and roll this with the blade of a knife upon a piece of glass or graduated tile to about the thickness of an ordinary writing pencil and divide into equal portions, and roll each between the thumb and forefinger until quite round and smooth. A little practice in this will soon make perfect. Except for very large quantities an ordinary mahogany-frame pill machine is sufficient."

Ink for Posters.—H. P. (*Plaistow*) writes in reply to A. J. (*Ilkeston*) (see page 494):—"You should get your stationer to order a sixpenny or shilling bottle of Mordan's waterproof ticket ink, F. Mordan, 326, City Road, London, E.C."

Lacquer for Iron and Steel.—R. G. (*Birmingham*) writes in reply to STEEL (see page 526):—"Tubbs & Wilkins, Hockley, Birmingham, make the above, all colours."

Working Drawing of Tramcar.—F. C. (*Leytonstone*) writes in reply to J. W. F. (*Lancaster*) (see page 526):—"I can supply you with a drawing of a tramcar as made by the best firm in London."

Trade Notes and Memoranda.

FIVE thousand plumbers are now enrolled on the register of the Plumbers' Company.

THE average number of men employed per diem on the Forth Bridge during the three months of the busiest time was 2,293. Only one fatal accident, and this we are informed was due to the workman's own want of caution, has occurred during the quarter.

THE directors of the Forth Bridge Railway Company recently visited the bridge by the aid of a gangway over the gap at the north girder, and walked on the bridge from the south to the north shore of the Forth. The first to cross were Mr. Thomson, chairman of the Forth Bridge Company and the Midland Company, and Miss Taylor, daughter of General Taylor. They were followed by Lord Colville, chairman of the Great Northern Railway, and Mr. Dent, the chairman of the North-Eastern Company. The party returned to Queensferry by steam barge.

ACCORDING to a recent publication of the Statistical Bureau at Berlin, four-fifths of the steam machinery in the world has been constructed within the last twenty-five years. France has 49,500 stationary boilers, 7,000 locomotives, and 1,700 ship boilers; Austro-Hungary, 12,000 stationary boilers and 2,400 locomotives. In the United States, the steam machinery, exclusive of locomotives, has 7,500,000 horse-power; in Germany, 4,500,000 horse-power; in France, 3,000,000 horse-power, and in Austro-Hungary, 1,500,000 horse-power. There are some 105,000 locomotives in the world.

THE London correspondent of the *Manchester Guardian* says a movement is on foot to establish a house-to-house heating supply, similar to that of gas and water. The system consists in the constant circulation of water at a high temperature and pressure (viz., at 400 degrees Fahrenheit and 250 lbs. on the square inch) from the batteries of boilers at a central station through the supply mains, and back to the boilers by return mains, the circulation being maintained by means of pumps. The loss of heat by radiation has been reduced to a minimum by covering the mains with a non-conducting material. Service boxes sufficient to heat three houses would be placed under the footpaths. From these boxes the house supply would be taken by means of copper pipes. At the end of the copper pipe, and inside the house, is fixed a vessel called a "converter," which permits the water to resolve itself into steam, the pressure of which is controlled by a reducing valve fixed on the copper pipe before it enters the "converter." From this "converter" the house service would be taken.

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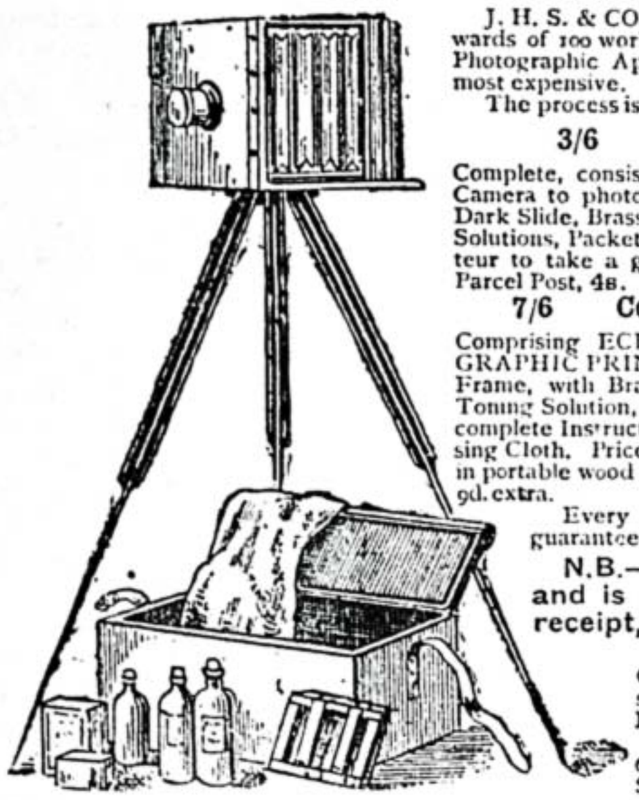

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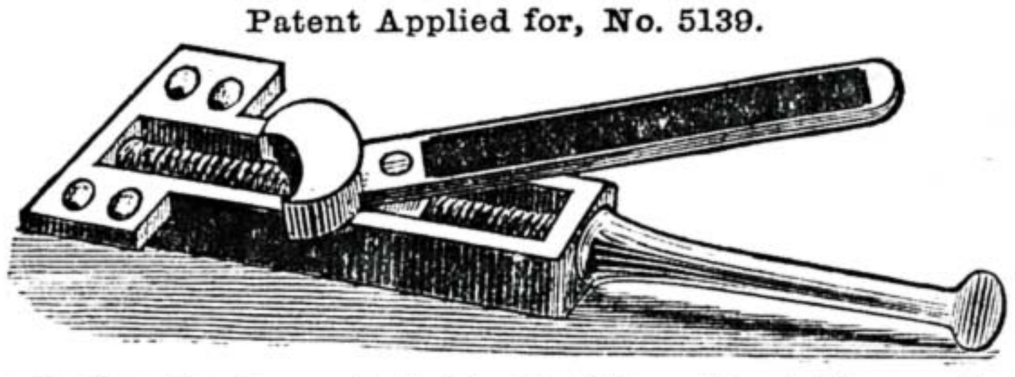

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